



# Current Science, Vol. XXV, 1956

## Author Index

	PAGE		PAGE
ABHYANKAR, S. G.—see also Patel, M. K.	299	CHACRAVARTI, A. S.—see also Srivastava,	
—see also Thirumalachar, M. J.	93	D. P.	302
Advani, (Miss) M. K. and Gatha, K. M.	53	Chandrasekaran, K.	388
Agarwal, B. K.	112	Chandrasekaran, K. S. (Rev.)	66
Agarwal, R. A.	26, 129, 332	Chandrasekharan, P.—see also Raman,	
Agarwal, S. K.	84	V. S.	64, 195
Ahluwalia, Y. K.—see also Mehta, A. C.	367	Chandrasekariah, P.—see also Seth, R. N.	92
Ahuja, M. R. and Johri, B. M.	162	Chandrasekhar Aiya, S. V. (Rev.)	339
Alam, M. N.—see also Trivedi, J. P.	89	Chatterjee, B. and Ray, A.	12, 220
Anantakrishnan, S. V. (Rev.)	371	Chatterjee, D.	252
Ananthakrishnan, T. N.	225	Chaudhari, B. B.	330
Aravamudan, G. and Krishnaswami, K. R.	287	Chiddarwar, P. P.	267
A. R. (Rev.)	271	Chiranjeebi, A.—see also Patnaik, D.	55
Asija, G. L. and Subbiah, B. V.	259	Chitale, A. G.	85
Asundi, R. K. and Joshi, B. D.	150	Chona, B. L. and Kapoor, J. N.	375
Aswatha Narayana, N. V.	88	C. P. G. (Rev.)	32, 99
BAKR AHMED, M. and Magdi Tewfik	192	DALAL, (Miss) S. R.	220
Balakrishnan Nair, R. and Gurumani,		Damodaran, M. (Rev.)	170
O. N.	361	Daniel, A.	21
Banerjee, N. R. and Seshadri, T. R.	143	— and Srinivasan, V. V.	59
Bap Reddy, D.	160, 303	Das, P. K. and Patnaik, D.	337
Barna, D. N.	249	Dasgupta, S. R.	17
Baxi, M. B., Sinha and Roy, R. P.	268	Datta, R. M.	207
Bhagavan, H. N. and Rajagopalan, R.	223	Daya Krishna	27
Bhat, N. R. and Krishnamoorthi, T.	297	Desai, M. K.—see also Hegde, R. K.	330
— and Patel, C. T.	29	Desai, M. N. and Trivedi, A. K. M.	354
Bhatia, C. M. and Panigrahi, G.	300	Desai, P. J. and Ramakrishnan, C. V.	189
Bhatnagar, A. N.	402	Deshpande, R. B. and Jeswani, L. M.	201
Bhatnagar, G. S.	100	Dey, D. C.—see also Sanyal, A. K.	227
Bhatt, J. G.	262	Dhanda, M. R.—see also Seth, R. N.	92
Bhatt, V. V.—see also Patel, M. K.	299	Dhillon, H. S.—see also Seetharaman, C.	199
Bhattacharya, A. K.	115	Dhopata, S. G. and Vyas, G. N.	356
Bhattacharya, D. L. and Saraswathy		Dikshit, N. N.	27
Royan (Miss)	155	Dnyansagar, V. R. and Tiwari, D. K.	16
Bheemasankara Rao, Ch. and Venkates-		Duggal, V. P. (Rev.)	30
warlu, V.	328, 357	Dutt, A. K.—see also Shri Ranjan	228
Bhide, V. P.—see also Hegde, R. K.	330	Dutt, N. L. (Rev.)	136, 172, 340
Bird, G. W. G.	116	E. P. G. (Rev.)	34
Borgaonkar, D. S. and Pawar, M. S.	241, 269	Elchidana, D. N. and Sukheshwala, R. N.	411
Boriah, G. and Govindappa, D. A.	403	Ethirajan, A. S. and Rao, J. T.	160
Borreswara Rao, C. and La Fond, E. C.	77	Eva Mitra	25
Bose, J. L. and Shah, R. C.	333	GAIND, V. S. and Mukherji, S. M.	336
Bowden, S. T.	82	Ganapathi, K. (Rev.)	97, 204, 306, 372
Brahm Prakash (Rev.)	236		



	PAGE		PAGE
Ganapati, P. N. and Nagabhushanam, R.	156	Kamala Sohonie and Rajagopal, M. V.	327
— and Narasimha Rao, M. V.	360	Kamat, D. N. and Pishawikar, S. D.	263
Ganguly, J. and Patel, S. M.	216	Kamat, V. B.—see also Panse, T. B.	261
Gatha, K. M. and Advani (Miss) M. K.	53	K. A. N. (Rev.)	307
— and Shah, G. Z.	113	Kapoor, J. N.	369
Giri, K. V. (Rev.)	67, 135, 373	— and Chona, B. L.	375
— and Pillai, N. C.	188	Kar, S. B.—see also Rath, D. N.	304
— and Ramasarma, T.	215	Karamchandani, S. J.	126
Gopalakrishna, K. V.	49	Karkhanavala, M. D.	166, 303
Gopalakrishnan, V. R.—see also Seetha-		Katti, M. R. and Tawde, N. R.	253
raman, C.	199	Kausik, S. B. and Raju, M. V. S.	296
Gopala Menon, S.	9, 355	Khan, M.Q.—see also Rao, A. S.	266
Gopalan, M. R. and Santhappa, M.	116	—see also Sastry, S. K.	295
Gopinath Kartha	141	Khandelwal, D. P. and Pant, D. D.	255
Goswami, S. K.	365	Khanna, K. L.—see also Srivastava, D. P.	302
Govindachari, T. R. (Rev.)	341	—see also Subba Rao, M. S.	159, 265
Govindan, T. K.	262	—see also Wakhlee, J. L.	265
Govindappa, D. A.	198	Khanolkar, V. R.—see also Panse, T. B.	261
— and Boriah, G.	403	— (Rev.)	407
Govindarajan, V. S. (Rev.)	69	Kharkar, D. P. and Patel, C. C.	56
Gupta, U. S.—see also Sengupta, S. R.	94	Khosho, T. N.	165
Gurdip Singh and Mehra, P. N.	168	Khosla, B. H.	11
Gurnani, (Miss) S. U.—see also Sahasra-		Khurchandani, P. G.	285, 323
budhe, M. B.	90	Kothari, D. S.	317
Gurumani, O. N. and Balakrishnan		Kothari, L. S. and Singvi, K. S.	286
Nair, R.	361	— and — (Rev.)	409
Guruswami, M. N.—see also Vaidya-		Krishnamachari, S. L. N. G.	185, 260, 355
nathan, T. S.	119	Krishnan, M. (Rev.)	206
HALDANE, J. B. S.	75	Krishnan, R. S. (Rev.)	308
Halleppanavar, N. L. and Kulkarny, H. L.	62	Krishna Pillai, V.	293
Harland, S. B. (Rev.)	69	Krishnamurthy, K. and Swaminathan, M.	16
Harnath, P. B. V. and Tiruvenganna		Krishnamurthy, T. and Bhat, N. R.	297
Rao, P.	47, 151, 184, 256	Krishnamurthy, T. R.—see also Vaidya-	
Hegde, R. K., Bhide, V. P. and Desai,		nathan, T. S.	119
M. K.	330	Krishnamurty, V. N.	289
Hiregaudar, L. S.	197, 334	Krishnaswami, K. R. and Aravamudan, G.	287
INDIRA, (Miss) M.—see also Sirsi, M.	15	— and Srinivasan, V.	328
Iswar Dass—see also Mehta, A. C.	367	Krishnaswamy, N.—see also Raman,	
Iyengar, S. B. D. (Rev.)	374	V. S.	64, 195
JAIN, S. K.	208	Kshira Sagar, T. V. S. R. and Sarma,	
Jatar, D. P. and Sharma, H. D.	324	B. B. G.	54
Jayaraman, V. S. (Rev.)	406	Kulkarni, S. A.—see also Pawar, M. S.	269
Jaya Rao, A. M. and Puranik, P. G.	153	Kulkarny, H. L.	21
Jeswani, L. M. and Deshpande, R. B.	201	— and Halleppanavar, N. L.	62
Jha, J. N.—see also Sharma, S. L.	274	Kumta, V. S.—see also Sahasrabudhe,	
Joginder Nath and Swaminathan, M. S.	123	M. B.	90
Johar, D. S. and Lewis, Y. S.	325	Kurup, P. A.	57
John, C. M. and Seshadri, C. R.	233	K. V. (Rev.)	133, 203, 405
Johri, B. M. and Ahuja, M. R.	162	LADDHA, G. S. (Rev.)	171
Johri, G. N.	193	La Fond, E. C.	40
Johri, M. P.	291	— and Borreswara Rao, C.	77
Joshi, B. D. and Asundi, R. K.	150	Lall, J. M.—see also Seth, R. N.	92
KAJJARI, N. B.	333	Lewis, Y. S. and Johar, D. S.	325
Kalapesi, R. M. and Purohit, B. L.	400	Loyal, D. S. and Mehra, P. N.	363

	PAGE		PAGE
MADHAVAN NAIR, A. P. (Rev.)	306	Natarajan, A. T. and Swaminathan,	
— and Ibrahim, S. H.	10	M. S.	279, 382
Magdi Tewfik and Bakr Ahmed, M.	192	Nayak, N. A. and Prakash Rao, M. S.	255
Mahadevan, C. and Prasada Rao, R.	385	Nayar, K. K.	192, 275
Mahadevan, V. (Rev.)	237	Negi, N. S.—see also Subba Rao, M. S.	159
— and Venkatakrishnan, R.	223	Ninan, C. A.	161
Mahapatra, G.—see also Patnaik, D.	55		
Maheshwari, K. L.—see also Sengupta,		PADMAVATHI, P. B. and Seshachar, B. R.	281
S. R.	94	Panda, S. and Patnaik, D.	287
Maheshwari, P.	106	Pandalai, K. R.	18, 368
Malaviya, B.—see also Shri Ranjan	228	Pandey, A.	148
Manas, K. Jana and Sen, N. K.	231	Panigrahi, G.	230
Mani, G. S. (Rev.)	370	— and Bhatia, C. M.	300
Mary Chandy, (Miss)	342	Panse, T. B., Kamat, V. B. and Khanol-	
Mathur, A. C.	127	kar, V. R.	261
Mathur, R. N.	337	Panse, V. G. (Rev.)	98
Meenakshi, (Miss) V. R.	124, 321	Pant, D. D. and Khandelwal, D. P.	255
Mehra, P. N. and Gurdip Singh	168	Parameswaran, S.	250
— and Loyal, D. S.	363	Patel, C. C. and Khankar, D. P.	56
Mehta, A. C., Ahluwalia, Y. K. and		Patel, C. T. and Bhat, N. R.	29
Ishwardass	367	Patel, M. K., Bhatt, V. V. and Abhyan-	
Menon, T. C. K. and Sugathan, K. K.	85	kar, S. G.	299
Manezes, F. G. T. and Phatak, S. S.	403	— and Srinivasan, M. C.	366
Mierzecki, R.	200	—see also Thirumalachar, M. J.	64, 93
Misra, G. and Samantarai, B.	61	Patel, S. M. and Gangul, J.	216
Misra, J. N. and Vijayaraghavan, P. K.	229	Patil, R. P. (Rev.)	373
Mitra, G. N.	401	Patnaik, D., Mahapatra, G. and Chiran-	
Mitra, S. N.—see also Sanyal, A. K.	227	jeebi, A.	55
Moghe, D. N. and Wagh, R. V.	83	— and Panda, S.	287
Mohd. Samiullah	353	— and Das, P. K.	337
Moitra, S. K.	292	Pawar, M. S. and Bargaonkar, D. S.	241, 269
Moniz, L.—see also Thirumalachar, M. J.	64	—, Bargaonkar, D. S. and Kulkarni, S. A.	269
Moosath, S. S.	14	Phadke, R. J.	56
— and Rao, M. R. A.	14	Phansalkar, S. V. and Ramachandran, M.	260
Mukherji, B. (Rev.)	236	Phatak, S. S. and Menezes, F. G. T.	403
Mukerji, D. and Raychaudhuri, S.	60	Pillai, N. C. and Giri, K. V.	188
Mukherji, S. M. and Gain, V. S.	336	Pillai, S. C. (Rev.)	408
Munshi, M. C. (Rev.)	133	Pillay, K. K. (Rev.)	98
Murthy, D. V.—see also Rao, A. S.	266	Pishawikar, S. D. and Kamat, D. N.	263
—see also Sastry, S. K.	295	Poornachandra Rao, C.	51
Murthy, G. V. L. N.—see also Subba		Prabhu, S. S. and Srivastava, P. N.	58
Rao, D.	187	Pradhan, S. and Sharma, G. C.	22
Murty, K. S.	186	Prakash Rao, M. S. and Nayak, N. A.	255
Muthukrishnan, T. S.	234	Prasad, H. H. and Singh, R. K.	137
M. V. R. and S. M. P. (Rev.)	205	Prasad, R. S.—see also Subba Rao, M. S.	265
Myer, Y. P.—see also Singh, D. D.	394	Prasada Rao, R. and Mahadevan, C.	385
		Puranik, P. G. and Jaya Rao, A. M.	153
NAGABHUSHANAN, R. and Ganapati, P. N.	156	Puri, B. R.—see also Singh, D. D.	395
Nagaraja Rao, A.	128	Purohit, B. L. and Kalapesi, R. M.	400
Naik, R. M. and Merchant, J. R.	324	Purushothaman, C. R. and Shivananda	
Nair, N. C.	264	Tolpadi, S.	392
Narasimha Rao, D. V. G. L.	217		
— and Radhakrishna Murty, Ch.	49	RADHAKRISHNA MURTY, CH. and Narasimha	
Narasimha Rao, M. V. and Ganapati, P. N.	360	Rao, D. V. G. L.	49
Narayan, V. A. and Vasudeva Murthy,		Raghava Rao, Bh. S. V. and Sarma,	
A. R.	145	D. V. N.	358
Narayana, C. S. and Rangaswami, S.	359	Rajagopal, M. V. and Kamala Sohoni	327

	PAGE		PAGE
Rajagopalan, R. and Bhagawan, H. N. . .	223	Ray, A. and Chatterjee, B. . .	12, 220
Rajagopalan, V. R. (Rev.) . .	172	Raychoudhury, S. and Mukerji, D. . .	60
Rajan, S. V. . .	195	Roy, R. P. and Baxi M. B. Sinha . .	268
Rajendranathan Nayar, M.—see also		Roy Tapador, N. N. and Sen, N. K. . .	125
Valsan, A. P. . .	396		
Raju, M. V. S. and Kausik, S. B. . .	296	SADASIVAN, T. S. (Rev.) . .	238, 240
Ramachandran, G. N. (Rev.) 30, 32, 270, . .	271	—see also Sulochana, (Miss) C. B. . .	301
— and Raman, S. . .	348	Sadhu, D. B. and Sailan Mookerjee . .	221
Ramachandran, M. and Phansalkar, S. V. . .	260	Sahasrabudhe, M. B. (Rev.) . .	66
Ram Chandra Rai . .	411	—, Gurnani, (Miss) S. V. and Kumta, . .	
Ramachandra Rao, B. and Ramanna, . .		V. S. . .	90
K. V. V. . .	234	Sailen Mookerjee and Sadhu, D. P. . .	221
—and Ramakrishna Raju, M. . .	390	Samantarai, B. and Misra, G. . .	61
Ramachandra Rao, L. and Someswara . .		Sampooran Singh . .	50
Rao, C. . .	393	Sanghvi, L. D.—see also Vyas, G. N. . .	290
Rama Char, T. L. . .	97	Santappa, M. . .	387
Ramakrishnan, A. (Rev.) . .	96	— (Rev.) . .	305
Ramakrishnan, C. V. and Desai, P. J. . .	189	— and Gopalan, M. R. . .	116
— and Sekhara Varma, T. N. . .	395	— and Subramanian, R. V. . .	218
Ramakrishnan, K. P. (Rev.) . .	203	Santamma, V. . .	149
Ramakrishna Raju, M. and Ramachandra . .		Sanyal, A. K., Dey, D. C. and Mitra, S. N. . .	227
Rao, B. . .	390	Saraswathi-Devi, (Miss) L.—see also	
Ramana Rao, D. V. . .	258, 337	Sulochana, (Miss) C. B. . .	301
Ramanadhan, R. and Subrahmanyam, . .		Saraswathy Royan, (Miss) . .	397
V. P. . .	167	— and Bhattacharya, D. L. . .	155
Ramanathan, K. R. (Rev.) . .	66	Sarma, B. B. G. and Kshira Sagar, . .	
Ramanathan, V. S. and Ratnam, C. V. S. . .	182	T. V. S. R. . .	54
Raman, C. V. . .	377	Sarma, D. V. N. and Raghava Rao, . .	
Raman, P. S. . .	326	Bh. S. V. . .	358
Raman, S. and Ramachandran, G. N. . .	348	Sarma, G. P. . .	360
Raman, V. S., Krishnaswamy, N. and . .		Sarma, P. S. (Rev.) . .	
Chandrasekharan, P. . .	64, 195	68, 170, 205, 307, 341, 372, 400	
Ramanna, K. V. V. and Ramachandra . .		— and Sivaramakrishnan, V. M. . .	288
Rao, B. . .	284	— and Srinivasan, V. (Rev.) . .	134
Rama Rao, L. . .	44	Sastri, R. L. N. . .	401
Rama Rao, R.—see also Sirsi, M. . .	15	Sastry, S. K., Khan, M. Q. and Murthy, . .	
— and Sirsi, M. . .	357	D. V. . .	295
Ramaratnam, S.—see also Rath, D. N. . .	304	Saxena, D. B. . .	23, 87, 227
Ramasarma, T. and Giri, K. V. . .	215	Seetharaman, C., Gopalakrishnan, V. R. . .	
Ramaseshan, S. and Sivaramakrishnan, V. . .	246	and Dhillon, H. S. . .	199
Ramaswami, L. S. . .	19	Sekhara Varma, T. N. and Ramakrishnan, . .	
Ramaswami, T. R.—see also Subba Rao, D. . .	187	C. V. . .	395
Ramji Tiwari . .	389	Sen, N. K. and Manas K. Jana . .	231
Ram Udar . .	222	— and Roy Tapador, N. N. . .	125
Ramdas, A. K. . .	257	Sengupta, S. R., Gupta, U. S. and . .	
Ranganathan, S. and Swaminathan, S. . .	6	Maheshwari, K. L. . .	94
Rangaswami, S. and Narayana, C. S. . .	359	Senich Radomir—see also Sukh Dev . .	118
Rao, A. S., Khan, M. Q. and Murthy, D. V. . .	266	Seshachar, B. R. . .	46
Rao, C. R. (Rev.) . .	169	— and Padmavathi, P. B. . .	281
Rao, D.—see also Sharma, S. L. . .	274	Seshadri, C. R. and John, C. M. . .	233
Rao, H. S. . .	241	Seshadri, T. R. (Rev.) . .	169
Rao, J. T. and Ethirajan, A. S. . .	160	— and Banerjee, N. R. . .	143
Rao, M. R. A. and Moosath, S. S. . .	14	Seshappa, G. . .	121
Rath, D. N., Ramaratnam, S. and Kar, . .		Seth, B. R. (Rev.) . .	339
S. B. . .	304	Seth, R. N., Dhandra, M. R., Chandra- . .	
Ratnam, C. V. S. and Ramanathan, V. S. . .	182	sekariah, P. and Lall, J. M. . .	92
Raut, H. K. . .	152	Setty, T. H. V. . .	218

	PAGE		PAGE
Shivananda Tolpadi, S. and Purushotta-		Subbiah, B. V. and Asija, G. L. ..	259
man, C. R. .. ..	392	Subrahmanyam, S. V. .. ..	51
Singh, D. D., Puri, B. R. and Myer, Y. P.	394	Subrahmanyam, V. P. and Rama-	
Singh, K. P. .. ..	59	nadhan, R. .. ..	167
Singh, R. K. and Prasad, H. H. ..	137	Subramaniam, M. K. (Rev.) ..	33, 273
Singh, R. P. .. ..	59	Subramanian, R. V. and Santappa, M. ..	218
Singvi, K. S. and Kothari, L. S. ..	286	Sugathan, K. K. and Menon, T. C. K. ..	85
—, and — (Rev.) .. ..	409	Sukh Dev, Senich Radomir and Sirsi, M. ..	118
Sinha, K. L. .. ..	335	Sukheswala, R. N. and Elchidana, D. N. ..	411
Sirsi, M., Rama Rao, R. and Indira,		Sukumaran, P. K.—see also Vyas, G. N. ..	290
(Miss) M. .. ..	15	Sulochana, (Miss) C. B., Sadasivan, T. S.	
—see also Sukh Dev .. ..	118	and Saraswathi-Devi, (Miss) L. ..	301
— and Rama Rao, R. .. ..	357	Sundaram, S. and Venkateswarlu, K. ..	354
Sivarajan, S. R.—see also Swami-		Sundara Rao, R. V. G.—see also Swami-	
nathan, S. .. ..	81	nathan, S. .. ..	81
Sivaramakrishnan, V. and Ramaseshan, S.	246	Sundara Rao, R. V. G. and Viswamitra,	
Sivaramakrishnan, V. M. and Sarma,		M. A. .. ..	115
P. S. .. ..	288	Sundara Rao, Y. .. ..	63, 164
Shah, G. Z. and Gatha, K. M. ..	113	Suresh Singh, Kr. .. ..	93
Shah, R. C. and Bose, J. L. ..	333	Suryanarayana Rao, S. V.—see also	
Shama Rao, H. K. .. ..	191	Valsan, A. P. .. ..	306
Sharma, G. C. and Pradhan, S. ..	22	Swaminathan, M. S. and Natarajan,	
Sharma, S. C. .. ..	120	A. T. .. ..	279, 382
Sharma, S. L., Rao, D. and Jha, J. N. ..	274	— and Joginder Nath .. ..	123
—see also Trivedi, J. P. .. ..	89	Swaminathan, S. .. ..	70
—see also Wakhloo, J. L. .. ..	265	— (Rev.) .. ..	204
Shri Ranjan, Dutt, A. K. and Malaviya, B.	228	— and Ranganathan, S. .. ..	6
S. M. P. and M. V. R. (Rev.) ..	205	—, Sivarajan, S. R. and Sundara Rao,	
Somayajulu, V. V. and Subba Rao, N. V.	86	R. V. G. .. ..	81
Someswara Rao, C. and Ramachandra			
Rao, L. .. ..	393	TALWAR, S. P. .. ..	4
Sreenivasan, A. .. ..	92	Tawde, N. R. and Katti, M. R. ..	253
Sreenivasan, A. and Venkataraman, R. 190,	294	Tewari, B. S. .. ..	274, 319
Srinivasan, K. V. .. ..	299	Tewari, H. B. .. ..	24
Srinivasan, M. C. and Patel, M. K. ..	366	Thangaraj, M. A. (Rev.) .. ..	132
Srinivasan, N. R. (Rev.) .. ..	272, 274, 305	Thirumalachar, M. J., Abhyankar, S. G.	
Srinivasan, V. and Krishnaswamy, K. R.	328	and Patel, M. K. .. ..	93
— and Sarma, P. S. (Rev.) .. ..	134	—, Moniz, L. and Patel, M. K. ..	64
Srinivasan, V. V. and Daniel, A. ..	59	Thosar, B. V. (Rev.) .. ..	31
Srinivasa Rao, M. R. .. ..	13	Tiruvenganna Rao, P. and Haranath,	
Srivastava, D. L. (Rev.) .. ..	68	P. B. V. .. ..	47, 151, 184, 256
Srivastava, D. P., Chacravarti, A. S. and		Tiwari, D. K. and Dnyansagar, V. R. ..	16
Khanna, K. L. .. ..	302	T. R. G. (Rev.) .. ..	31
Srivastava, G. P. .. ..	111	Trivedi, A. K. M. and Desai, M. N. ..	354
Srivastava, K. P. .. ..	226	Trivedi, J. P., Sharma, S. L., Srivastava,	
Srivastava, P. N. and Prabhu, S. S. ..	58	R. C. and Alam, M. N. .. ..	89
Srivastava, R. C.—see also Trivedi, J. P.	89	UDGAONKAR, B. M. (Rev.) .. ..	131
Srivastava, S. N. S. .. ..	157	VAIDYANATHAN, T. S., Guruswami, M. N.	
Srivastava, V. K. .. ..	158	and Krishnamurthy, T. R. .. ..	119
Subba Rao, D., Murty, G. V. L. N. and		Valsan, A. P., Suryanarayana Rao, S. V.	
Ramaswami, T. R. .. ..	187	and Rajendranathan Nayar, M. ..	396
Subba Rao, M. .. ..	164	Vasudeva Murthy, A. R. and Narayan,	
Subba Rao, M. S., Negi, N. S. and		V. A. .. ..	145
Khanna, K. L. .. ..	159	Venkatachala, B. S. .. ..	89
—, Prasad, R. S. and Khanna, K. L. ..	265	Venkatakrishnan, R. and Mahadevan, V. ..	223
Subba Rao, N. V. .. ..	396	Venkata Ram, C. S. .. ..	329
Subba Rao, M. G. (Rev.) .. ..	97, 272		

	PAGE		PAGE
Venkataraman, R. and Sreenivasan, A.	190, 294	Vyas, G. N. and Dhopata, S. G.	356
Venkataraman, S.	179	—, Sukumaran, P. K. and Sanghvi, L. D.	290
Venkateswarlu, K. and Sundaram, S.	354		
Venkateswarlu, V. and Bheemasankara Rao, Ch.	328, 357	WAGH, R. V. and Moghe, D. N.	83
Verma, S. C.	398	Wakhloo, J. L., Sharma, S. L. and Khanna, K. L.	265
Vijayaprasanthan Pillai, K.	362	Wazir, S. N.	248
Vijayaraghavan, P. K. and Misra, J. N.	229		
Viswamitra, M. A. and Sundara Rao, R. V. G.	115	YEGNANARAYANAN IYER, G.	224
Viswanathiah, M. N.	114	Y. N. (Rev.)	339

## Subject Index

	PAGE		PAGE
ABSORPTION Spectrum of Uranyl Nitrate in Aqueous Solutions	255	Animal Nutrition (Rev.)	171
Abstract Bibliography of Cotton Breeding (Rev.)	69	Annual Review of Biochemistry, Vol. 24 (Rev.)	68
Acridines (Rev.)	406	Antibiotics Annual (Rev.)	305
Adsorption of CO by Ni: Formation of Nickel Carbonyl	328	— and Cancer (Rev.)	66
— of Iodine on Cellulose from Organic Solvents	85	Antibiotic Principle of Leaves of <i>Withania somnifera</i>	57
Advances in Carbohydrate Chemistry, Vol. III (Rev.)	31	Antibiotics Symposium	35
— in Carbohydrate Chemistry, Vol. IX (Rev.)	341	Antiproton, The	39
— in Enzymology, Vol. XVI (Rev.)	135	Applied Biology (Rev.)	136
— in Protein Chemistry, Vol. X (Rev.)	371	Approximate Solution in Einstein's Field Theory of 1953	389
— in Veterinary Science, Vol. II (Rev.)	237	Apterous, Brachypterous and Macrop- terous Forms, Occurrence in <i>Haplo- thrips apicalis</i> Bagnall	225
Afferent Branchial Arteries, Arrange- ment in <i>Anabas testudineus</i>	87	<i>Arachis hypogaea</i> Linn. var. <i>Oleifera forma erecta</i> Seshadri (Forma nova)— A New Groundnut	233
— Branchial Arteries in <i>Mastacembelus armatus</i>	23	Artificial Inoculation of Cotton Plants with <i>Macrophomina phaseoli</i> , Tech- nique for	64
Agar Electrophoresis of Hæmoglobins	188	Ascorbic Acid Synthesis in Molds: Effect of addition of Fe, Co and Ascorbic Acid	189
Air Bubbles in Wet Mounts, Method for Removing	241	— —, Relation to Fusarium Wilt in Linseed	262
Algæ and Fungi, Monographs on	311	Asian Wild Life Conservation	101
Alepisaurid Fishes— <i>Discovery Reports</i> , Vol. 27 (Rev.)	32	Assay Methods of Antibiotics (Rev.)	97
Algal Cultures free from Associated Micro-Organisms, Method for Obtain- ing	94	Associateship Examination, 1956—Insti- tution of Chemists (India)	102
<i>Alternaria zinnæ</i> Pape in India	374	Atomic Energy Board in U.S.S.R.	173
Aluminium Directory, 1955	138	— Structure of Solids, Code for	241
— with the Hardness of Steel	375	Auditory Reaction Time as Function of Frequency of Single Tone	255
Amperometric Estimation of Germanium	10	Aureomycin (Traces) for Food Preserva- tion	174
Anatomical Defects of the Reproductive Organs in Cattle in Uttar Pradesh	291	—, Nitrite and Ricinoleate: Effect on Red Halophilic Bacteria	190
Analogue of Papavarine, Synthesis of	262	Automatic Rainfall Stations in Japan	310
Anatomy of the Digestive System of Indian <i>Mantis</i> Sp.	195		
Ancient India (Rev.)	98		

	PAGE		PAGE
Available Nitrogen in Soils, Procedure for Rapid Estimation .. ..	259	Chemistry at Poona University ..	276
Award of Research Degree 36, 72, 102, 138, 174, 208, 242, 276, 311, 344, 376, 412		— of Ferrocene and Related Compounds ..	6
BACTERIAL Red Stripe Disease of Sugar-cane Caused by <i>Xanthomonas rubrilineans</i> in Bombay State .. ..	330	Chromatographic Behaviour of Some Cations .. ..	218
Banana Wilt Disease .. ..	101	Chromosome Botany (Rev.) .. ..	372
Bathymetographs—An Oceanographic Tool .. ..	40	Chromosome Breakage Induced by Vegetable Oils and Edible Fats .. ..	382
B-Chromosomes in <i>Panicum coloratum</i> .. ..	123	— Number of a Pigmented <i>Annona squamosa</i> L. .. ..	269
Benjamin Franklin—250th Anniversary .. ..	74	— Number of Man .. ..	322
Benthic Organisms of a Fresh-Water Fish-Tank .. ..	158	<i>Cleome monophylla</i> , New Bacterial Leaf-Spot on .. ..	93
Benzoin Condensation of Salicyl Aldehyde .. ..	56	Coarse Grating, Use in Finding the Wavelength of H. F. Sound Waves in a Liquid .. ..	355
Bhilai Steel Project .. ..	183	<i>Cocculus hirsutus</i> (Linn.) Diels., Chemical Investigation of .. ..	324
Bibliography of Botany in Western India .. ..	275	Coal Carbonization .. ..	412
Birbal Sahni Institute of Palaeobotany .. ..	208	Coimbatore Canes in Cultivation (Rev.) .. ..	407
Bird Navigation (Rev.) .. ..	206	Colonel Amir Chand Trust Prizes for Medical Research .. ..	174
Blue Peroxy Chromic Acid .. ..	411	Colorimetric Method for Estimation of Butylated Hydroxyanisole in Fats .. ..	16
Bombay Natural History Society .. ..	36	Colour as a Factor Influencing the Settlement of Barnacles .. ..	21
Boron Monoxide, Some New Bands of .. ..	253	Common Cultivated Crops of South India (Rev.) .. ..	340
Botanical Research Institute in Kashmir .. ..	344	Comparative Flowerweight in Common Jasmines .. ..	100
Broken Bonds in Kaolinite .. ..	12	Condition Factor in Some Fishes of Lucknow, U.P. .. ..	292
Bromine, New Emission Spectrum in Far and Vacuum Ultraviolet .. ..	256	Congress on Theoretical and Applied Mechanics, Second .. ..	311, 351
<i>Bulletin of Polish Medical History and Science</i> .. ..	412	Copper Ethyl Sulphate, Unit Cell Dimensions and Space Group of .. ..	81
<i>Cajanus cajan</i> Millsp., New Mutation in .. ..	333	<i>Corchorus aestuans</i> L. (= <i>Corchorus acutangulus</i> Lamk.), Occurrence of .. ..	207
Calcium Oxalate Crystals as Index of Nutrient Uptake in Tea Plant .. ..	249	Corday-Morgan Commonwealth Fellowship .. ..	344
Cancer, Control of .. ..	43	Corona Theorem for Air under L. F. Discharge Using a Maze Counter .. ..	324
Carotenoid in <i>Pila virens</i> (Lamarck) .. ..	124	Correlation between Conductivity, Swelling and Shrinkage Properties of Ceramic Clays .. ..	115
Carp Fry, Mortality due to Infection by a Parasite Ciliate .. ..	126	Cosmic Ray Activity, February 22, 1956 .. ..	207
<i>Cassia tora</i> Linn. Isolation of Three Crystalline Substances from Seeds of .. ..	359	<i>Corynebacterium renale</i> , Occurrence in Goats .. ..	92
Cell Growth, Study of .. ..	35	CO <sub>2</sub> Evolution in Ensilage .. ..	223
<i>Centranthera humifusa</i> as Hemi-Root Parasite .. ..	274	Chrome Tanning Industry and Tanning Processes .. ..	72
<i>Cercospora</i> , New Species on an Economic Host .. ..	267	Chromosome Number of <i>Sesbania cinerascens</i> .. ..	241
Ceric Acetate, Preparation in Anhydrous State, and its Photo and Thermal Decompositions .. ..	287	Crystalline Components of Certain Indian Pines .. ..	367
Cestodes of Whales and Dolphins from the Discovery Collection—Discovery Reports, Vol. 27 (Rev.) .. ..	99	Crystallography, Symposium on .. ..	141
Chemical Applications of Spectroscopy (Rev.) .. ..	308	Currents in Biochemical Research (Rev.) .. ..	406
— Engineering (Rev.) .. ..	272		
— Industry in Europe (Rev.) .. ..	171		
Chemical Components of Pods of <i>Tephrosia purpurea</i> var. <i>Maxima</i> Baker .. ..	396		
— Effect of Gene Mutation .. ..	411		

	PAGE		PAGE
Cytology and Anatomy of <i>Hypodematium crenatum</i> (Forsk.) Kuhn., Some Observations on .. .. .	363	Eimeria, New Species from a Cow-Calf in Bombay State .. .. .	197
— of <i>Gloriosa</i> .. .. .	165	Elastic Constants of Thallium Alum .. .. .	51
— of India <i>Gleicheniaceæ</i> .. .. .	168	— Scattering of 90 Mev. Neutrons by Copper .. .. .	113
— of <i>Ophioglossaceæ</i> .. .. .	161	Electronic Computer in Scientific Research .. .. .	104
— of <i>Ophioglossum</i> .. .. .	398	Embryology of Angiosperms—A Retrospect and Prospect .. .. .	106
Cytoplasmic Details of Yeast Revealed by Electron Microscope .. .. .	155	Embryo Sac Haustoria in <i>Cassytha filiformis</i> Linn. .. .. .	401
DAS, PROF. B. M. (Obituary) .. .. .	352	Emission Bands of Benzonitrile .. .. .	150
Deep Ocean Currents, Measurement of .. .. .	173	— Spectrum (New) of Iodine in the Far and Vacuum Ultraviolet .. .. .	151
Diamond as a Pin-Point Radiation Counter .. .. .	212	<i>Endeavour</i> Prizes .. .. .	137
— Tool Industry in 1955 (Rev.) .. .. .	171	Endemic Fluorosis .. .. .	35
Dielectric Behaviour of Mixture of Polar Gases at Microwave Frequencies .. .. .	111	Endosperm Development and Nuclear Polyembryony in <i>Aegle marmelos</i> Correa .. .. .	162
— Properties of Ethyl Acetate in Ultra H. F. Region .. .. .	49	Energy Release in Atmosphere at High Altitudes .. .. .	130
Diffraction Method (New) for Measuring Ultrasonic Velocities in Liquids .. .. .	390	Equation of State of Zinc from Thermal Data .. .. .	392
Digestive Enzymes of <i>Martesia striata</i> Linn. .. .. .	156	Equilibrium Configurations of Oblate Fluid Spheroids under the Influence of Magnetic Field .. .. .	4
Dilutors for Buffalo Semen .. .. .	58	Eriophyid Mite on Sugarcane in S. India .. .. .	234
Dipole Moment and Relaxation Time in the 3 cm. Region, Determination of .. .. .	49	Ethyl Malonate as Inhibitor for Termite Cellulase .. .. .	229
— Moments of Ethylene Chloro- and Bromo-Hydrins .. .. .	217	Euphauseacea of the Benguela Current— <i>Discovery Reports</i> , Vol. 27 (Rev.) .. .. .	32
Direct Solar and Diffuse Sky Radiation during Solar Eclipse, Observations on .. .. .	167	Evolvine, Preliminary Note on Pharmacology of .. .. .	119
Disposal of Sewage (Rev.) .. .. .	408	Expanding Universe .. .. .	137, 278
Dominant (Twin-Bolled) 'Cluster' in <i>Hirsutum</i> Cotton .. .. .	29	Experiments with Weightlessness .. .. .	342
Duel Jr., Harry James (Obituary) .. .. .	216	FAO FISHERIES Officer for Asia and the Far East .. .. .	174
Dykes in Deep-Silted Swamps, New Technique for Construction of .. .. .	401	Fast Neutron Radiation and Localised Chromosome Breakage .. .. .	279
EDITORIALS: Atomic Energy Development in India .. .. .	277	Fermentation Process for Production of Quality Fish Meal .. .. .	293
—: Genetic Effects of Radiation .. .. .	243	Ferric Ammonium Paramolybdate .. .. .	258
—: India's Resources in Atomic Minerals .. .. .	37	First Congress on Theoretical and Applied Mechanics .. .. .	3
—: Mineral Resources and Their Problems .. .. .	1	Fishing Gear Congress .. .. .	242
—: Problem of Domestic Fuel .. .. .	73	—, Scientific Aid to .. .. .	375
—: Prof. S. Chandrasekhar as Astrophysicist .. .. .	139	5:7-Dibromo-8-quinolinol Complex of Molybdenum .. .. .	337
—: Progress of Fisheries Development in India .. .. .	175	Foot and Mouth Diseases of Cattle, Immunisation with Crystal Violet Vaccine .. .. .	199
—: Quantum Theory and Crystal Physics .. .. .	377	Force Constants of Some Radicals of $\text{XF}_6$ Type .. .. .	354
—: Scientific Value of Artificial Satellites .. .. .	345	Forecasting Heavy Rainfall in Malabar, S. Kanara and Travancore-Cochin during June and July .. .. .	335
—: Training and Research in Applied Mathematics .. .. .	103		
—: Utilisation of Solar Energy .. .. .	209		
—: World Resources of Energy .. .. .	313		
Efferent Branchial Arteries of <i>Anabas testudineus</i> and <i>Ophicephalus striatus</i> , Similarity of .. .. .	227		

	PAGE		PAGE
Foreseeable Future (Rev.) ..	95	High Energy Nuclear Physics (Rev.) ..	131
Fossil Holothurian Sclerites (Rev.) ..	339	— Polymers—Polymer Processes (Rev.) ..	305
4-Acetomethyl Coumarin Derivatives, Synthesis of ..	333	— Vacuum Technique (Rev.) ..	66
'Frontoparietal' Bone in Arura (Amphi- bia) ..	19	Histidine, Conversion to Urocanic Acid in Germinating Seeds ..	288
Freezing Points of Adsorbate Liquids ..	394	Histopathology of Nephrotic Kidney, Studies on ..	221
Fungal Infections (Two) of Hevea Seeds	157	Hinshelwood, Sir Cyril ..	80
$\gamma$ -(3-Indolyl)- <i>n</i> -butyric Acid on Leaf Movement of <i>Mimosa pudica</i> Linn. in Diffused Daylight and Artificial Light	228	Hora, Dr. S. L. (Obituary) ..	46
GAMETOPHYTE (Female), Development in <i>Biophytum sensitivum</i> (L.) DC ..	403	Hormones, Effect on Germination in Loquat Pollan ..	27
Geological, Mining and Metallurgical Society of India ..	71	Humidity (Rev.) ..	203
Germination of Turions in <i>Hydrilla</i> <i>verticillata</i> Presl. ..	25	Huttonite and Monazite, Syntheses of ..	166
Gift of Rare Australian Specimens ..	242	Hydraulics Research at Kharagpur ..	310
<i>Gigantocotyle explanatum</i> (Paramphisto- matidae Trematoda), Effect of Tem- perature on Development of Miracidia	93	Hydrogen Ions, Vol. I (Rev.) ..	97
<i>Globidium leuckarti</i> (Flesch) from a Horse in India ..	334	IBR AND ICL, New Emission Spectra of	184
Glutathione (Rev.) ..	170	I.F. Electric Discharge, Influence of Light Intensity on Characteristics of Non- Self-Maintained Region ..	11
Glycine Soja Agglutins, Nature of ..	116	Illite, Behaviour on Repeated Salt Treatment and Desaturations ..	220
Glycolytic Enzymes in <i>Phaseolus radiatus</i> (Greengram) ..	215	Illustrations for Publication, Prepara- tion of ..	147
Gondwanaland, Some Problems of ..	44	Indian Botanical Society ..	36
Gravitational Field of Distant Rotating Masses ..	83	— Fungi, List of ..	344
Growth Factors in Culture Filtrates of Fusaria, Detection of ..	329	— Pharmaceutical Congress, 9th ..	421
Growth of Sand Bar North of Godavari Confluence ..	385	— Phytopathological Society ..	36
HÆMAGGLUTININS, Occurrence in Calf Vaccine Lymph ..	289	— Society for the History of Science ..	72
Half-Wave Potentials and Atomic Characteristics ..	358	— Science Congress, 1957 ..	8
Halogen-Ion Concentration, Effect on Milk Coagulation by Pepsin ..	263	— Soils, Survey and Classification of ..	79
Heat and Specific Heat of Mixing of He <sup>3</sup> and He <sup>4</sup> Solutions ..	112	India's First Atomic Reactor ..	245
<i>Hemicyclia travancorica</i> Bourd, Correct Name of ..	208	— Mineral Wealth (Rev.) ..	305
Heterocyclic Compounds with Indole and Carbazole Systems—Chemistry of <i>Heterocyclic Compounds</i> , Vol. VIII (Rev.) ..	133	Indo-Canadian Technical Co-operation	275
Heterosporium Disease of Garden Nastur- tium, Occurrence in India ..	369	Infectious Hepatitis, Treatment of ..	105
Hexachloroceric Acid, Isolation of ..	14	Inference in Time Series ..	80
Hexabromide Test (Modified) for Detec- tion of Linseed and other Highly Un- saturated Oils in Mustard Oil ..	227	Infrared Spectrum of Ortho-fluorobromo- benzene ..	355
		Inorganic Nitrogen Metabolism (Rev.)	238
		Institution of Telecommunication Engi- neers, India ..	72, 376
		Intensity of Raman Lines in Spectra of Pyridine in Acetic Acid ..	200
		Internal Frames and Form of an Equa- tion of State of Thermodynamic Sys- tems ..	353
		International Atomic Energy Agency	178, 352
		— — — Course for Management ..	35
		— Cloud Atlas ..	342
		— Conference on Tuberculosis, 14th ..	343
		— Congress on Cybernetics ..	173
		— — on Rheumatic Diseases, 9th ..	275
		— Dairy Congress, 14th ..	102
		— Geological Congress, 20th ..	318
		— Review of Cytology, Vol. III (Rev.)	33
		— — —, Vol. IV (Rev.) ..	273



	PAGE		PAGE
Intertrappean Fossil from near Bombay	411	Macronuclear Reorganisation in <i>Diophrys appendiculata</i> ( <i>Ciliata hypotricha</i> )	360
Interspecific Hybrid of Grain Sorghum and Johnson Grass : <i>S. halepense</i> ( $2n=20$ ) $\times$ <i>S. roxburghii</i> ( $2n=20$ )	195	Madras University Prizes	138
Intra-nuclear Neurosecretory Matter in Tadpoles of <i>Rana hexadactyla</i> Lesson, Occurrence of	362	Magnetic Crystals by Hydrothermal Method	343
Introduction to Atomic and Nuclear Physics (Rev.)	132	— Measurements and Biological Substances	241
— to Reactor Physics (Rev.)	30	— Refrigerator	207
— to Theoretical Organic Chemistry (Rev.)	70	Making Atoms Visible	100
Ion Pair Ferric Oxalate as Initiator in Vinyl Polymerizations	218	Mass Spectrometer Researches (Rev.)	206
<i>Iphita limbata</i> Stal, Effect of Extirpation of Neurosecretory Cells on Metamorphosis of	192	Mahadevan, Prof. C.	276
Iron Chlorosis in Young Pear Trees, Treatment of	192	Male Sterile Mutant in <i>N. tabacum</i>	297
—, Estimation by Iodimetry	55	Marine Bacteria, New Species Tolerating High Concentration of Copper	92
—, New Reagent for Gravimetric Estimation of	59	Mechanical Testing and Inspection of Engineering Materials (Rev.)	406
— Ores of India (Rev.)	272	Megaspores in Coal from South Rewa Gondwana Basin, Occurrence of	365
Isolation of a Steroid Fraction from Inflammatory Exudate	220	Meiotic Studies in <i>Adiantum peruvianum</i> Klotz.	268
— of Invertebrate Hormones	275	Mermethid Worm Parasite, Occurrence on <i>Helopeltis theivora</i> Water-house	60
Isotopes and Isobars in Alpha and Beta Decay, Variation of Number of	152	Merril, Dr. E. D. (Obituary)	252
Isotopic Gas Analysis for Biochemists (Rev.)	170	Metabolic Meiotic Irregularities in <i>Cyclosorus repandulus</i> (v.A.v.R.) Ching	230
<i>Johnius hololepidotus</i> (Lacepede), Occurrence in Indian Waters	121	Metamict Hematite	303
KÄMMERERITE from Sindhuvali Mines, Mysore District	114	Methods in Enzymology, Vol. 1 (Rev.)	67
Kalinga Prize Award to Prof. Gamow	347	— — —, Vol. 2 (Rev.)	373
Kashmir Lignite, Utilization Possibilities of	248	— of Biochemical Analysis, Vol. 3 (Rev.)	307
Kerosene, High Quality	242	Methyl Bromide as Plant Fumigant	160
Krishnan, Dr. K. S.	202	— Ethyl Ketone Peroxide as Initiator in Vinyl Polymerization	116
<i>Kittada coimbatorensis</i> Gen. et Sp. Nov. —New Genus of Indian Itonididae	129	Microfilm and Photoscopy Service	311
LADY TATA Scholarships and Grants for 1956-57	5, 181	Microscope Slides, Duty on	235
Law and the Engineer (Rev.)	133	Microscopy of Ceramics and Cements (Rev.)	271
Lesion (Unusual) in Subentis of a Fowl due to the Fungus of <i>Aspergillus</i> sp.	400	Microsporogenesis of <i>Fimbristylis quinquangularis</i> Kunth.	16
Lignite Material, Occurrence in Godavari Delta	54	Mineral Beneficiation and Extractive Metallurgical Techniques	311
Lipochromes of <i>Gyrostoma</i> Sp.—Sea Anemones	327	Miniature Batteries for Scientific Apparatus	411
MACERATION AND BLEACHING Osmium Blackening in Root Tips of <i>Oryza</i> , Combined Technique for	191	Mixed Nitrogen Phosphorus Fertilizer	101
<i>Macrocephalus</i> (so-called) Beds of Kutch	84	Molecular Fragments, Storing	343
		Morphology of Sucking Pump of <i>Papilio demoleus</i> Linn. (Lepidoptera)	226
		Multiple Spot Phenomenon in Inorganic Circular Paper Chromatography	145
		Multi-Purpose Food	207
		— Particle Accelerator	100
		Mutation Rates Produced by High Energy Events in Mammals, Estimation of	75
		Mycophagous Insects (Some) and Their Parasites Associated with Sugarcane	332
		Mysidacea—Discovery Reports, Vol. 28 (Rev.)	99

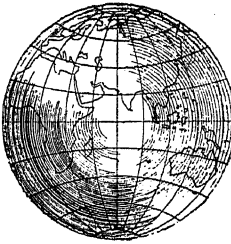
	PAGE		PAGE
N: N'-DIALKYLETHYLENE Diamine Salts of Penicillin G .. ..	356	Permeability of Vitelline Membrane of Trout-Egg .. ..	28
National Institute of Sciences of India ..	36	Peroxy Titanium Oxalate .. ..	56
Near-Ultraviolet Absorption Spectra of Certain Substituted Heterocyclic Compounds .. ..	149	Perspectives and Horizons in Microbiology (Rev.) .. ..	69
Nematode Galls on a Grass, <i>Dicanthium annulatum</i> .. ..	303	<i>Phalacrus immarginatus</i> Champ. (Black Beetle), Record of Feeding on Sugarcane Smut .. ..	26
Neurosecretory Cells in <i>Calotes versicolor</i> — Pathways in <i>Calotes versicolor</i> ..	18 368	— — — (Coleoptera, Phacridæ), Earlier Record of .. ..	337
Neutrons, Slowing Down in Be from 1.44 ev. to Thermal Energy ..	286	<i>Phaseolus trilobus</i> , New Bacterial Leaf-Spot on .. ..	299
New Transistor for Very High Frequencies .. ..	100	Photometry of Telescopes and Binoculars ..	276
Niels Bohr and the Development of Physics (Rev.) .. ..	270	Photoperiodic Behaviour of <i>Thailand</i> , a Philippanese Variety of Rice ..	61
Nobel Award for Chemistry, 1956 ..	387	<i>Physics and Chemistry of Solids</i> ..	376
— — for Physics, 1956 .. ..	388	Physics of Fibres (Rev.) .. ..	271
Nodal Galls, Occurrence in Sugarcane ..	295	Physiology of Hibernation of <i>Pila virens</i> (Lamarck) .. ..	321
Non-Ferrous Metal Industry in Europe (Rev.) .. ..	274	Placentation in <i>Melia azadirachta</i> Linn. ( <i>Azadirachta indica</i> Juss) ..	264
Normal Ceric Hydroxide, Preparation of NSF Institutes for Science and Mathematics Teachers .. ..	14 208	Plasma $\alpha$ -amino- <i>n</i> -butyric acid in Health and Disease .. ..	224
Nuclear and Jet Power, New Metals for Nuclear Reactors, Catalogue of ..	173 388	<i>Pectropoma maculatum</i> Bloch in Indian Sea .. ..	342
— Research, Advanced Training in ..	310	Pleiotropy, A Case in Pigeon Pea ..	201
— Scattering of High Energy Electrons by Light Elements .. ..	53	Plutonium, Utilization of .. ..	375
— Science and Engineering .. ..	72	Polymyxin, Neomycin and Bacitracin (Rev.) .. ..	204
Nutgrass, Chemistry and Antibacterial Activity of .. ..	118	Polyovular Pollicles in <i>Semnopithecus entellus</i> , Peculiar Mode of Origin of ..	24
Nutrition Research Laboratories (Rev.) ..	205	Polyploidy in <i>Allamanda</i> .. ..	125
O-AMINOPHENOL, Condensation from Aromatic Aldehydes .. ..	86	Pongamol, Some Reactions of .. ..	355
Optical Behaviour of Iridescent Sodium Nitrate Crystals .. ..	257	Post-Notal Plates of Insects, New Stage in Evolution of .. ..	127
Organic Insecticides—Their Chemistry and Mode of Action (Rev.) ..	169	Power Reactors—Peaceful Uses of Atomic Energy, Vol. 3 (Rev.) .. ..	370
Organic Insecticides—Their Chemistry and Mode of Action (Rev.) ..	169	Practical Solution of Torsional Vibration Problems (Rev.) .. ..	339
Organic Insecticides—Their Chemistry and Mode of Action (Rev.) ..	169	Pre-Natal Diagnosis of Sex .. ..	242
Organic Insecticides—Their Chemistry and Mode of Action (Rev.) ..	169	Primary Cosmic Radiation .. ..	42
Origins of Resistance to Toxic Agents (Rev.) .. ..	68	Principles and Practice of Field Experimentation (Rev.) .. ..	98
Overthrust Structure (Large) Near Debipur, W. Bengal .. ..	304	Prize for Essay on Relativity .. ..	310
PAPER CHROMATOGRAPHIC Technique to Detect Organic Acids in Citrus Plant Tissues ( <i>Citrus acida</i> ) .. ..	395	<i>Prodecatoma pongamiae</i> Mani and Kurian (Hymenoptera-F a m. Eurytomidæ), Life-History and Host-Range of ..	62
Particle Size Determination (Rev.) ..	97	Production Functions for Large-Scale Establishments .. ..	148
Peaceful Uses of Atomic Energy ..	41	— Technology of Materials Used for Nuclear Energy—Peaceful Uses of Atomic Energy, Vol. 8 (Rev.) ..	370
— — — — —: India and the United Kingdom .. ..	71	Progress in Nuclear Energy, Vol. I (Rev.) ..	408
Periodic Classification and Electronic Configuration of Elements .. ..	85	Progress in Nuclear Physics, Vol. IV (Rev.) .. ..	96

	PAGE		PAGE
Proteins, The Chemistry, Biological		Relativity for the Layman (Rev.) ..	31
Activity and Methods of, Vol. II (Rev.)	32	Respiration in Diencephalic Cats, Effect	
<i>Pseudomonas tuticorinensis</i> N. Sp.—A		of Frontal Section through Hypothal-	
Marine Denitrifying Bacterium ..	294	mus on .. ..	17
<i>Pseudonapomyza atra</i> on Maize Leaves	160	<i>Riccia discolor</i> L. & L., Some Observa-	
— — Meigen (?) on Paddy ..	266	tions on .. ..	89
Pulses, Absence of True Vitamin B <sub>12</sub>		<i>Riccia</i> , Two Species New to India ..	232
Activity .. ..	260	Rocket Flight round the Moon ..	375
Pyrilla, Mode of Feeding of ..	265	Role of History of Science ..	343
<i>Pythium catenulatum</i> Mathews, caus-		Rothamsted Experimental Station Report,	
ing Sugarcane Seedling Root Rot ..	299	1954 (Rev.) .. ..	172
QUALITATIVE Organic Analysis and		Royal Institute of Chemistry, N. India	
Scientific Method (Rev.) ..	341	Section .. ..	376
RADIOACTIVE Cobalt, New Use for ..	241	Royal Society and Nuffield Foundation	
Radiation Hazards, Genetics Congress		Commonwealth Bursaries Scheme ..	412
Resolution on .. ..	375	Russian Periodicals, Standard Transla-	
— Problems, Studies on .. ..	181	tions of .. ..	310
Radioactive Materials, Value to Dairymen	174	<i>Saccharum spontaneum</i> Linn., Relation-	
— Tracers, Use in the Study of Plant		ship between Flowering Age and	
Physiology .. ..	34	Height .. ..	89
— Yttrium in the Treatment of Cancer	208	Saha, Prof. M. N. (Obituary) ..	315
Rain-Making: Its Present Position and		Sampurnanand (Dr.) Prize ..	208
Future Possibilities (Rev.) ..	67	Salt in Rajasthan, Origin of ..	411
Raman Spectrum of <i>m</i> -fluorobromo-		Sand Sorting on East Coast Beaches ..	77
benzene .. ..	260	Satellite Programme of the U.S.A. ..	45
— — of <i>o</i> -fluorobromobenzene ..	185	Scattering and Diffraction of Radio	
— — of <i>p</i> -tolyl Isothiocyanate ..	153	Waves (Rev.) .. ..	66
Ramdas, Dr. L. A. ..	283	<i>Scilla hohenackeri</i> Fisch. and Mey., Fur-	
<i>Rana tigrina</i> Daud., Some Abnormalities		ther Studies on .. ..	63
in Venous System .. ..	120	— <i>indica</i> Baker, Development of Endo-	
Raptakos Fellowships for Medical		sperm in .. ..	198
Research .. ..	36, 208, 242	— — in India .. ..	164
Rare-Earths: Polarographic Behaviour		Scintillation Counter for Human Subjects	71
and Electronic Configurations ..	358	Sedimentary Environments off Kalinga-	
<i>Rauwolfia</i> Alkaloids, Effect on Some		patam—Gopalpur Coast by Coarse-	
Endocrine Functions .. ..	15	Fraction Studies .. ..	154
— —, Use in Avian Malaria ( <i>P. galli-</i>		Selenium dioxide Dehydrogenation of	
<i>naceum</i> ) .. ..	357	Flavonones, Mechanism of ..	143
— for Research .. ..	35	<i>Senga lucknowensis</i> , New Cestode from	
Raw Hides and Skins—Curing and Pre-		<i>Mastacembellus armatus</i> Lacep. ..	193
servation, Symposium on .. ..	412	Sex Mechanism in <i>Dysdercus</i> (Pyrrho-	
R.B.C. Count and Altitude, Relation		coridæ-Heteroptera) .. ..	360
between .. ..	186	Shipworm (New) from Tondi, S. India	361
Reactors—Progress in Nuclear Energy		<i>Shorea robusta</i> Gaertn., Life-History of	128
Series, Vol. 2 (Rev.) .. ..	374	Shrimp Ground along Indian West Coast	207
Reactor Technology and Chemical Pro-		Silver Jubilee Souvenir, 1955, Society of	
cessing—Peaceful Uses of Atomic		Biological Chemists (Rev.) ..	205
Energy, Vol. 9 (Rev.) .. ..	370	Sickle-Cell Trait in Some Tribes of	
Recent Progress in Hormone Research,		Western India .. ..	290
Vol. XI (Rev.) .. ..	134	Silicon Powder Rectifier .. ..	100
Reduced Temperature Scales ..	82	Simultaneous Signal Strength Measure-	
Reduction with Complex Metal Hydrides		ments on Continuous and Pulsed Radio	
(Rev.) .. ..	203	Wave Transmissions reflected from	
Regional Research Laboratory, Hyderabad	173	Ionosphere .. ..	284
Relative Merits of Soil Conditioners ..	102	6-Hydroxy Flavonols, Synthesis by Algar	
		Flynn Reaction .. ..	393

	PAGE		PAGE
Solar Electric Station, World's First ..	317	Tetrazolium Reduction as Index of Spoilage in Cured Fish ..	396
Solubility Apparatus, Efficient ..	287	Theoretical Principles of Organic Chemistry (Rev.) ..	204
Some Beautiful Indian Climbers and Shrubs (Rev.) ..	238	Thermonuclear Reactions (Controllable) by means of Gas Discharges ..	213
— — — Trees (Rev.) ..	238	Thermostatically-controlled Miniature Glass-House ..	301
— Extinct Elephants, Their Relatives and the Two Living Species (Rev.) ..	33	Thorium, Strengthening ..	72
<i>Sorghum nitidum</i> Pers., Studies on ..	64	Time, Choice between Atomic and Astronomical Standards ..	177
Sources of Eddington's Philosophy (Rev.) ..	131	Tiny Seed and Pod Segregates in <i>Cicer arietinum</i> ..	330
South Arcot Lignite Char, Utilization as Domestic Fuel ..	182	Tonoplast in Yeast ..	88
Southern Languages Book Trust ..	71	Total Body X-Ray Irradiation, Effect on the Levels of Tryptophane and Nicotinic Acid in Liver and Kidney of Rats ..	90
Soviet Journal of Atomic Energy ..	275	Trace Elements in Human and Animal Nutrition (Rev.) ..	341
— Union, University Research in ..	343	Transactions of the Archæological Society of South India (Rev.) ..	307
<i>Spirochlypeus</i> from Kutch, W. India ..	319	Transitional Elements of Fe Group, Highly Water-Reactive Forms of ..	187
Spermatagonial Chromosomes of <i>Riopa punctata</i> (Gmelin) ..	402	Treatise on Inorganic Chemistry (Rev.) ..	306
Spontaneous Autotetraploid Gram, A ( <i>Cicer arietinum</i> L.) ..	231	<i>Trifidaphis gossypii</i> Sp. Nov. (Fam. Aphididæ), New Species of Aphid Pest on Cotton in Bombay Karnatak ..	21
— Variegated Chimæra in <i>Dianthus chinensis</i> L. ..	300	Tritium Estimation in Water Samples ..	101
Static and Dynamic Electron Optics (Rev.) ..	31	<i>Trogoderma granarium</i> Everts ( <i>Khapra</i> ), Control of ..	22
— Electricity by Radioactive Substances, Elimination of ..	173	Tropical Vegetation, Study of ..	71
Statistical Methods for Agricultural Workers (Rev.) ..	169	Tuberculosis Vaccines ..	142
Steels for the User (Rev.) ..	236	2, 4-D, Soil Application to increase Sugar in Cane ..	302
Steel Targets attacked by Explosives with Lined Cavities ..	50	ULTRASONIC VELOCITY in Solids, New Method of Measuring ..	9
Steroids in Human Smegma ..	261	UNESCO'S First Ten Years ..	384
Streptomycin, Manufacture of ..	275	Unit Cell and Space Group of Aluminium and Cobalt Acetylacetonates ..	285
Stress-Optic Dispersion in Glasses ..	274	— — — and Space Group of Cheralite ..	323
Structure Analysis of Non-Centrosymmetric Crystals, New Method for ..	348	— — — — — of Cupric Ammonium and Potassium Oxalates ..	115
— Pattern of Certain Granitic Bodies from Mysore ..	13	University Teachers, Training of ..	147
— Reports, Vol. 9 (Rev.) ..	270	VACUUM Valves in Pulse Technique (Rev.) ..	339
Sugarcane, Response to Sulphanilamide ..	265	Variations in Pre-Embryo Development in <i>Utricularia cœrulea</i> L. ..	296
Sulphur Deposit in Rup-Ganga Valley ..	274	Vanaspathi, Stability of Vitamin A in ..	403
Sutherland, Prof. G. B. B. ..	138	Vinylogues of $\beta$ -di- and $\beta$ -tri-ketones, Synthesis of ..	336
Synchronous Macronuclear Divisions in Multimicronucleate Ciliates ..	281	Virus Research (Rev.) ..	240
Synthetic Drugs (Rev.) ..	236	Viscosity of Solutions in Mixed Solvents ..	337
— Hormone, New ..	137	Visible Emission Bonds of $Cl^+_2$ , New Vibrational Analysis of ..	47
<i>Tamarindus indica</i> Linn. (Red Tamarind), Characterization of Pigment in ..	325		
Tandem Van de Graaff Generator ..	309		
Tartaric Acid, Action on Brass ..	354		
Tata Medal Award for Zoology ..	71		
Technology of Fish Processing ..	137		
Terramycin (Oxytetracycline)—Antibiotics Monograph No. 6 (Rev.) ..	372		
Tetralone Chemistry, Some Observations on ..	324		

	PAGE		PAGE
Vitamins, Recent Research on (Rev.) ..	205	XANTHOMONAS, Three Undescribed Species of .. ..	366
Vitexin frm <i>Vitex peduncularis</i> Wall ..	328	X-Ray Diffraction in Polycrystalline Materials (Rev.) .. ..	30
WASTE Heat from Nuclear Reactors, Use of .. ..	101	YEAST, Relation between the Nucleus and the Vacuole .. ..	397
Water Requirements of Crops, Apparatus for	250	ZONATE Leaf-Spot Disease of Jowar ..	137
— — of Wheat: Variety Kenphad, ..	179	Zoological Society of India ..	208
for Determination of .. ..	250		
Water-Masses in the Bay of Bengal ..	51		
Wind Power Utilization in India ..	180		
Wood-Boring Pholads (Two), Occurrence at Madras .. ..	59		

# Current Science



Vol. XXV]

JANUARY 1956

[No. 1

	PAGE		PAGE
<i>Mineral Resources and Their Problems</i>	1	<i>The Chemistry of Ferrocene and Related Compounds—S. SWAMINATHAN AND S. RANGANATHAN</i>	6
<i>First Congress on Theoretical and Applied Mechanics</i> .. .. .	3	<i>Indian Science Congress, 1957</i> ..	8
<i>Equilibrium Configurations of Oblate Fluid Spheroids under the Influence of Magnetic Field—S. P. TALWAR</i> ..	4	<i>Letters to the Editor</i> .. .. .	9
<i>Lady Tata Scientific Research Scholarships, 1956-57</i> .. .. .	5	<i>Reviews</i> .. .. .	30
		<i>Use of Radioactive Tracers in the Study of Plant Physiology</i> .. .. .	34
		<i>Science Notes and News</i> .. .. .	35

## MINERAL RESOURCES AND THEIR PROBLEMS\*

FROM the dawn of human civilisation, man had used mineral products, a few at first and more as time went on. The process was slow in the beginning and even at the dawn of the Industrial Revolution, only a few mineral products were used. But during the present century, mankind has used more metals and minerals than during all its long civilised existence. Modern industry is expanding at an ever-increasing pace, and almost every country is now bent upon industrialisation, and the already industrialised countries are steadily expanding their activities. Unlike the products of the animal and vegetable kingdoms, mineral resources are not renewable seasonally or annually, and only under exceptional conditions can supplies be replenished quickly, like sulphur in areas where volcanoes are active. The only way to replace mineral deposits which have been depleted is to find new ones wherever they might occur.

The relative abundance and distribution of the elements in the earth's crust is well known, but it is not their relative abundance that matters so much as the degree of concentration and the quantity in which they are gathered up by natural processes. Such concentrates are our ore and mineral deposits. Most of the ore deposits are usually derived through the agency of magmatic processes, being associated with igneous rocks and emanations. Both the grade of the ore and tonnage have a definite relation to what we consider a workable deposit. What we call a low grade is dependent on economic considerations of winning the useful mineral first by separating it from the unwanted minerals and waste rock, and then processing or smelting it to concentrate the mineral or metal into a usable form. The average content of uranium in rocks of the crust is of the order of two parts in a million. But it will be a very costly proposition to mine half-a-million tons of rock to process it and recover 1 ton of uranium whose market value at present is roughly Rs. 35,000 to Rs. 40,000. Barely a decade ago, a workable uranium ore had to

\* Abstract of the Presidential Address of Dr. M. S. Krishnan, Director, Geological Survey of India, to the 43rd Indian Science Congress, held at Agra, January 1956,

contain not less than 2% of that element. But the demand that has been created after the discovery of atomic energy makes it now worthwhile to mine and process an ore containing only 0.1% uranium.

As is well known, only a few limited areas in the world have been searched intensively for minerals. Such areas are to be found around the North Atlantic, *viz.*, in Western Europe and North America. In other parts of the world, only a few small areas have been examined in detail. The greater part of South America, Africa and Asia remain to be explored with care. In Asia and Africa there are regions which have not yet been mapped geologically. Under the circumstances, it is reasonable to expect that intensive exploration and prospecting would lead to the discovery of a number of mineral deposits of which some at least would be of importance.

In all countries, early in the process of industrialisation only the richest deposits exposed at the surface were worked and utilised locally or exported. Much wastage occurred at this stage. This was soon followed by industrial development marked by the setting up of metallurgical, chemical and engineering works. The national wealth and prosperity of a country increased during this stage. The third stage is a period of depletion of cheap domestic mineral resources and import of raw materials from outside for feeding local industries. Thereafter comes the stage of having to depend on foreign ore and other raw materials, leading gradually to the loss of competitive power in foreign markets, due to the necessity for purchase of much of the raw material requirements from outside.

India is just passing through the first stage and entering the second. The further stages could be strengthened by careful husbanding of the resources by the adoption of conservation measures. An outstanding example in India, requiring the enforcement of conservation, to which repeated attention has been called, is the misuse of good coking coal for burning in boilers and locomotives for steam raising, for which non-coking coal of a similar grade would do quite well. It is only during the last four or five years that serious steps have been taken to prevent the objectionable use of coking coal.

Conservation has to be effected at all stages of the development of the mineral deposits, in mining, milling and ultimate utilisation. All technological advances in any of these stages automatically bring in improvements which are conducive to conservation. Conservation

is also achieved by substituting a more easily available and cheaper material for one which is costly or difficult to get. Substitution is often dictated by necessity, and will be acceptable so long as the easily available substitute is good enough for the purpose for which it is intended. Thus, though it may be worth while using a good grade of mica for all types of electrical insulation, a poorer insulator would serve for some purposes. Mica substitutes are, therefore, coming into use in the countries which have to import this mineral in large quantities.

It is an interesting fact that no mineral has become entirely obsolete and unusable. The pattern of use may change occasionally, but so long as a mineral finds some use, it continues to be employed until it is replaced by something more suitable or is used for some other special purpose. A good example is afforded by monazite for which the black sands of the Travancore coast were originally worked. It was then employed for the requirements of the gas mantle industry. But, after the First World War, the demand for the mineral fell and practically stopped, as gas had largely been replaced by electricity for lighting in Europe. In the meanwhile, ilmenite which is associated with the monazite, found use in the manufacture of a paint pigment—titanium white. This mineral rapidly assumed importance and monazite was nearly forgotten for a while. But during and after the Second World War, monazite has again attained prominence as a possible source of atomic energy because of its content of appreciable amounts of thorium and a little uranium. Ilmenite also continues to be utilised, so that at present there is a good demand for both these minerals.

The latest prophecy seems to be that atomic energy is going to make coal an unwanted material and that coal mining will be a thing of the past within a decade. But we may well ask whether all the uranium needed for bringing about such a complete revolution in the industrial set-up and power production will be available (as also other materials needed for regulation and control of the nuclear reactions) at a price which will compete seriously with coal. Similar prophecies were made about coal when large developments in the production of petroleum as well as of hydro-electricity took place three or four decades ago. There are as yet no signs of coal becoming unnecessary to mine.

Our present knowledge goes to show that we have only a few surpluses and quite considerable deficiencies in the list of useful mine-

erals needed for industry. There is a sufficiency of surplus in coal, ores of iron, manganese, aluminium, titanium, chromium, magnesium; mica, barytes, kyanite, sillimanite and various types of clays. The chief deficiencies are in copper, lead, zinc, silver, nickel, cobalt, molybdenum, tungsten, tin, antimony and mercury amongst the metals; and sulphur, phosphates, fluorspar, petroleum, potash, graphite, asbestos, amongst the non-metallic minerals. In almost every case our knowledge is confined to surface observations. We do not know enough about what lies below the surface even at shallow depths. There is, consequently, a chance of making good some of the deficiencies by extensive and intensive search in suitable areas.

Only during the last few years has the Geo-

logical Survey been strengthened suitably in personnel and equipment to face this task adequately. A Bureau of Mines has been established to look after the work of improving the techniques and standard of mining and enforcing mineral conservation measures. An Oil and Natural Gas Division is being set up to undertake systematic and intensive exploration for petroleum. Within the Geological Survey itself there are specialist wings to study Mineral Deposits, Groundwater and Engineering Geology and to conduct Geophysical Exploration. The co-ordinated efforts of all these will be directed towards the study of all the phases of exploration and development of our resources in minerals, and will contribute steadily to the building up of a strong and prosperous nation.

### FIRST CONGRESS ON THEORETICAL AND APPLIED MECHANICS

THE First Congress on Theoretical and Applied Mechanics was held on the 1st and 2nd November 1955, at the Indian Institute of Technology, Kharagpur, under the Presidency of Dr. K. S. Krishnan, Director, National Physical Laboratory, New Delhi. Of the 147 delegates who registered themselves as members, 101 participated in the deliberations of the Congress. Fifty-two papers were read and were followed by lively discussion. Messages of goodwill were received from a number of distinguished workers all over the world.

Dr. S. R. Sen Gupta, Chairman of the Organizing Committee, stressed the need for both theoretical and experimental approaches to any problem of mechanics and advocated a harmonious blending of the two. This was followed by the Presidential Address on 'The Physics of Heated Filaments in Vacuum'. The theory developed by Dr. Krishnan knits into a single whole the uncorrelated empirical results obtained by various experimenters.

There was a half-hour address by Prof. N. Wiener on 'Some Formulæ in Meteorological Prediction'. He showed how with the help of a lemma formulated by him and Kolmogoroff, formulæ for multiple prediction may be developed making use of phase averages or time averages. Other addresses were by L. E. Payne 'On a Class of Problems in Plane Elasticity' and by V. M. Ghatage on 'Ring Aerofoils and Their Possible Use'. Dr. Payne showed how in the problem of semi-infinite elastic medium or of an infinite strip the use of dual integral equations may be avoided by a suitable decomposition of Airy's stress function. Dr. Gha-

tage indicated an interesting arrangement of a ring aerofoil and a source which could climb in the vertical direction without any horizontal race on the ground, and could also move backward or forward. Though a practical design of this type had not been worked out, it was quite feasible and deserved thought and consideration. A majority of the papers presented at the Congress dealt with problems on elasticity and plasticity. Among the other topics discussed were fluid mechanics, callistics, vibrations, thermodynamics, statistics and mathematical physics.

An *ad hoc* meeting was held for the formation of the Indian Society of Theoretical and Applied Mechanics. The following office-bearers were elected: Dr. K. S. Krishnan (*President*), Dr. V. M. Ghatage and Prof. N. R. Sen (*Vice-Presidents*), Prof. B. R. Seth (*Secretary-Treasurer*).

The First Congress on Theoretical and Applied Mechanics has served a useful purpose in bringing together workers in engineering science from all parts of India, and emphasising the need for producing engineer-scientists along with the establishment of colleges for producing working engineers. It may be essential for this purpose to enrol brilliant graduates from Indian Universities with high academic distinctions in basic sciences like applied mathematics, physics, chemistry, geology, geophysics and statistics, and engage them in research work in theoretical and applied mechanics and other basic subjects on which the science of engineering is built up.



# EQUILIBRIUM CONFIGURATIONS OF OBLATE FLUID SPHEROIDS UNDER THE INFLUENCE OF MAGNETIC FIELD

S. P. TALWAR

Dept. of Physics, University of Delhi, Delhi

RECENTLY G. Gjellestad<sup>1</sup> discussed the equilibrium configurations of gravitating incompressible fluid spheroids (homogeneous, inviscid and infinitely conducting) subject to a uniform magnetic field  $H$  inside and a dipole field outside. However, in her paper the sign of the integral in the first part of the equation (65) is incorrect. We give, in this note, the results of a more general study of the problem of the equilibrium of *oblate fluid spheroids* in the presence of a magnetic field which is assumed to be described by

(i) a uniform field  $H$  inside the spheroid in the  $z$ -direction, and

(ii) an external field made up of a uniform field  $kH$  along the  $z$ -direction and that due to a dipole of moment  $(1-k) \frac{H(1+E^2)^{\frac{1}{2}}}{Q_1^1(iE)}$  (the axis of the dipole being parallel to the  $z$ -direction) in order to make the normal component of the field continuous on the surface of the spheroid. Here  $E$  gives the boundary of the spheroid and the function  $Q_1^1(iE)$  is defined as

$$Q_1^1(iE) = (1+E^2)^{\frac{1}{2}} \frac{dQ_1(iE)}{dE}$$

$Q_1(iE)$  being the Legendre function of the second kind.

If we take  $k=0$ , we get a spheroid with a uniform magnetic field inside and a dipole field outside. This case is the same as that discussed by G. Gjellestad. But due to the inconsistency mentioned above, our subsequent results for the case  $k=0$  are different. The case  $k=1$  corresponds to a uniform field of the same value both inside and outside the spheroid. If we let  $k \rightarrow \infty$ ,  $H \rightarrow 0$  but  $kH = H_0$  remaining finite, it corresponds to an oblate spheroid under only an external field made up of a uniform field  $H$  in the  $z$ -direction superposed by a field due to a dipole of moment  $\frac{H_0(1+E^2)^{\frac{1}{2}}}{Q_1^1(iE)}$  in the antiparallel direction.

Under the influence of magnetic field of the characteristics mentioned above, we find that there exists a sequence of gravitating oblate fluid spheroids.

The spheroids are assumed to be infinitely conducting, incompressible non-rotating and situated in infinite empty space. Following G. Gjellestad we have used oblate spheroidal

co-ordinates which are defined in terms of the triple infinity of orthogonal surfaces provided by the confocal spheroids

$$\frac{x^2+y^2}{1+\xi^2} + \frac{z^2}{\xi^2} = c^2 \quad (0 \leq \xi \leq \infty) \quad (1)$$

the confocal hyperboloids

$$\frac{x^2+y^2}{1-\mu^2} - \frac{z^2}{\mu^2} = c^2 \quad (-1 \leq \mu \leq +1) \quad (2)$$

and the planes  $\phi = \text{constant}$  ( $0 \leq \phi \leq 2\pi$ ) (3) through the  $Z$ -axis. Here  $c$  is a constant equal to half the distance between the foci.

We investigate the stability of an oblate spheroid of boundary given by

$$\xi = E \quad (4)$$

by subjecting it to a general  $P_n$  deformation so that its boundary changes to one given by

$$\xi = E + \epsilon \frac{1+E^2}{E^2+\mu^2} P_n(\mu) \quad (n > 0) \quad (5)$$

where  $\epsilon$  is a non-dimensional constant.

Because of the deformation (5), there shall be a change  $\Delta Q$  in the gravitational potential energy of the spheroid and a change  $\Delta m$  in the total magnetic energy, which consists of two parts—the change,  $\Delta m^{(i)}$  in the magnetic energy inside the spheroid and the change,  $\Delta m^{(e)}$  in the external magnetic energy. We then employ the equilibrium condition

$$\Delta Q + \Delta m = 0 \quad (6)$$

in order to define the equilibrium spheroids.

We find that the total change,  $\Delta m$ , in the magnetic energy vanishes for odd values of  $n$ , whereas it is of the order  $\epsilon$  for all even ( $P_{2n}$ ) deformations, and is given by

$$\Delta m_{2n} = - \frac{H^2 c^3 (1+E^2)}{Q_1^1(iE)} \sum_{n=1}^{\infty} \left\{ \frac{(1-k)}{P_{2n}^1(iE)} - \frac{(1-k) \left(1 + \frac{k}{3}\right)}{4 [Q_1^1(iE)]} \int_{-1}^{+1} \frac{P_{2n}(\mu)}{E^2 + \mu^2} d\mu \right\} \epsilon_{2n} \quad (7)$$

where  $P_{2n}^1(iE)$  are defined as

$$P_{2n}^1(iE) = (1+E^2)^{\frac{1}{2}} \frac{dP_{2n}(iE)}{dE} \quad (8)$$

The functions  $P_{2n}(iE)$  denote the Legendre functions of the first kind.

The expression for the change,  $\Delta Q$  in the gravitational potential energy of a spheroid as derived by G. Gjellestad, is

$$\Delta\Omega = -\frac{3}{10} \frac{M^2 G}{c} \epsilon_2 \left[ \frac{3E^2+1}{E} \cot^{-1} E - 3 \right] \quad (9)$$

where  $M$  denotes the mass of the spheroid. The change in the gravitational potential energy of the spheroid is of the first order in  $\epsilon$  only for a  $P_2$  deformation and of higher order for all higher order deformations.

For a  $P_2$  deformation of the spheroid, for which both  $\Delta m$  and  $\Delta\Omega$  are of the order  $\epsilon$ , the condition

$$\Delta\Omega + \Delta m = 0$$

for equilibrium gives that a configuration is stable for  $P_2$  deformation if

$$H = H_{eq.} \left[ \frac{f(e)}{e^2 F_2(e)} \right]^{\frac{1}{2}} \quad (10)$$

where, for convenience, we have put

$$H_{eq.} = \sqrt{\frac{3}{10}} \frac{M\sqrt{G}}{a^2}$$

$a$ , being the major half-axis of the spheroid, and  $G$  the constant of gravitation.

Here the functions  $f(e)$  and  $F_2(e)$  are defined as

$$f(e) = \frac{3-2e^2}{e(1-e^2)^{\frac{1}{2}}} \cot^{-1} \left( \frac{1-e^2}{e^2} \right)^{\frac{1}{2}} - 3 \quad (11)$$

and

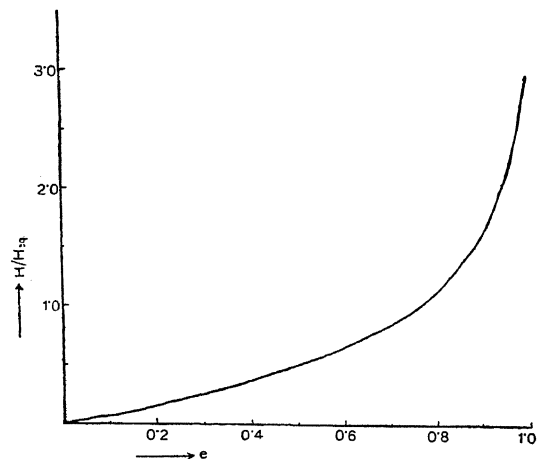


FIG. 1

$$F_2(e) = \frac{e^2 \left(1 - \frac{k}{3}\right)}{3(1-e^2)^{\frac{1}{2}} Q_1'(iE)} - \frac{(1-k) \left(1 + \frac{k}{3}\right)}{4 [Q_1'(iE)]^2} f(e) \quad (12)$$

( $e$  denotes the eccentricity of the spheroid).

The function  $H/H_{eq.}$  is plotted against  $e$  for the case  $k=0$  in Fig. 1, and for the other two cases in Fig. 2. We find that  $H/H_{eq.}$  increases with increase in the eccentricity for the three types of magnetic field discussed.

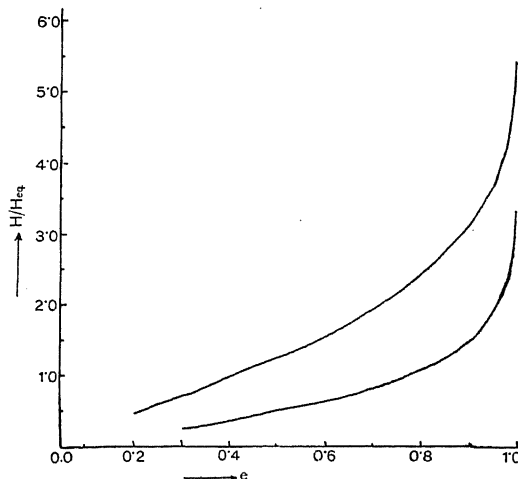


FIG. 2

However,  $H/H_{eq.}$  required for stability of the spheroid is more for the case when  $k \rightarrow \infty$ ,  $H \rightarrow 0$  but  $kH$  remaining finite ( $= H_0$ ). Thus we find that there exists a unique configuration for a spheroid which is stable for a  $P_2$  deformation for each of the three types of magnetic field under consideration.

The detailed paper shall be published elsewhere.

The author is highly indebted to Prof. D. S. Kothari and to Prof. F. C. Auluck for helpful discussion and constant encouragement.

I. Guro Gjellestad, *Astrophys. J.*, 1954, **119**, 14.

### LADY TATA SCIENTIFIC RESEARCH SCHOLARSHIPS, 1956-57

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1956-57 commencing from 1st July 1956. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of a scientist of standing in a recognised research institute or laboratory

on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trust and should reach by March 15, 1956. Candidates can obtain these instructions and other information they desire from the Secretary, the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay-1.

## THE CHEMISTRY OF FERROCENE AND RELATED COMPOUNDS

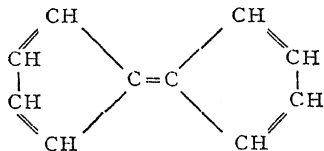
S. SWAMINATHAN AND S. RANGANATHAN

Dept. of Organic Chemistry, University of Madras

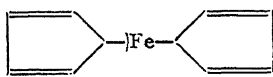
AS a possible route to fulvalene (I), Kealy and Pauson<sup>1</sup> studied the reaction between cyclopentadienylmagnesium bromide and anhydrous ferric chloride but obtained an orange crystalline compound which melted at 173-74° and was analysed for  $C_{10}H_{10}Fe$ . This compound was soluble in many organic solvents and in addition, was found to be remarkably stable towards acids and bases in striking contrast to the failure of earlier attempts to prepare compounds containing only carbon, hydrogen and iron. The authors suggested that the compound was formed according to the equation

$$2R\text{MgBr} + \text{FeCl}_3 \rightarrow R\text{FeR} + \text{MgBr}_2 + \text{MgCl}_2$$

after initial reduction of the ferric salt by the Grignard reagent. They formulated it as biscyclopentadienyliron (II) and attributed the stability of the compound to the tendency of the cyclopentadienyl group to become aromatic by acquisition of a negative charge, resulting in important contributions from the resonance form (III) and intermediate forms:

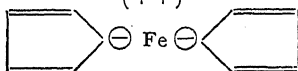


I



II

(++)

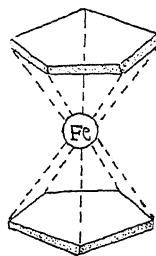


III

The isolation of the same compound was reported almost simultaneously by Miller *et al.*<sup>2</sup> who obtained it by reaction of cyclopentadiene at 300° with reduced iron. Biscyclopentadienyliron has since been prepared in excellent yield by reacting the pyridine complex of ferrous acetylacetonate with cyclopentadienyl magnesium bromide.<sup>3</sup>

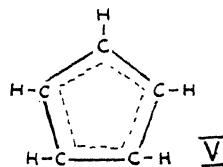
Woodward and co-workers<sup>4</sup> found that the compound was diamagnetic ( $\chi^{25^\circ} = -125 \times 10^{-6}$  C.G.S.U.) and that its infra-red spectrum contained in the  $3-4\mu$  region a single sharp band at  $3.25\mu$  indicative of the presence of C-H bonds of one type only in the molecule. The ultra-violet spectrum showed maxima at

$326m\mu$  and  $440m\mu$  and the dipole moment was almost zero. The compound was easily oxidised to a blue cation  $[\text{Fe}(\text{C}_5\text{H}_5)_2]^+$  which was isolated in the form of its double salts. In the light of these properties, Woodward *et al.*<sup>4</sup> preferred structure IV according to which two cyclopentadienyl units are bound covalently and symmetrically to ferrous iron. This structure has since been confirmed by X-ray structural studies.<sup>5-7</sup>

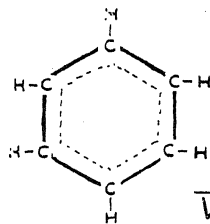


IV

Woodward *et al.*<sup>8</sup> while leaving open the question of the electronic structure of biscyclopentadienyliron, thought it likely that the equivalent ring bonds connecting the equivalent C-H<sub>2</sub> groups in the molecule might be of effective order greater than one and might result in a situation as represented in V and similar to what obtains in benzene (VI).



V



VI

This consideration led them to conclude that biscyclopentadienyliron might behave as an aromatic substance and to study some of its reactions which, indeed, established the aromatic nature of the compound which in consequence was named ferrocene.

Ferrocene does not have any properties typical of unsaturated compounds in spite of its formal unsaturation. It does not undergo a Diels-Alder reaction with maleic anhydride and cannot be hydrogenated. With acetyl chloride, in presence of aluminium chloride, it yields a red diacetyl derivative which gives a dioxime and which can be oxidised to a dicarboxylic acid; with  $\beta$ -chloropropionyl chloride and phthalic anhydride, the reaction is similar. With acetic anhydride in anhydrous hydrogen fluoride, monoacetylferrocene<sup>9</sup> is obtained. Ferrocene undergoes sulphonation and also condensation with aliphatic and aromatic aldehydes.<sup>9</sup> Strongly oxidising species such as  $\text{NO}_3^+$ ,  $\text{Br}^+$  effect oxidation to the cation, called ferricinium ion, instead of substitution. The infra-red carbonyl absorption maxima for some ketonic derivatives of ferrocene are almost the same as in the corresponding derivatives of benzene. The first dissociation constant of ferrocene dicarboxylic acid ( $\text{pK}_1$   $3.1 \times 10^{-7}$ ) is nearly the same as the dissociation constant of benzoic acid ( $\text{pK}$   $2.4 \times 10^{-7}$ ).

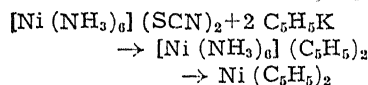
From the vapour pressures and vapour densities, the normal boiling point ( $249^\circ$ ), molecular weight (186), heats of sublimation (16.8 k. cal./mole) and vaporisation (11.3 k. cal./mole) and the triple point ( $183^\circ$ ) have been calculated.<sup>10</sup> From the measured heat of combustion of ferrocene, the combined energies of resonance of the five-membered rings and that of C-Fe bonds have been calculated<sup>11</sup> to be 113 k. cal. Such a high value accords with the stability of the compound. Accurate bond lengths are not available but the indications<sup>5-7</sup> are C-C 1.4 Å and Fe-C 2.0 Å.

Phenylcyclopentadienyl Grignard compounds react similarly to cyclopentadienylmagnesium bromide and a series of ferrocenes substituted by phenyl groups in both rings has been prepared.<sup>12</sup> Monophenylferrocene has been prepared by use of a mixture<sup>5</sup> of cyclopentadiene and phenylcyclopentadiene. The preparation of dibenzoferrrocene (bisindenyliron) and bisindenyl cobalt salts has also been described.<sup>13</sup> The preparation of 1, 1'-dibenzhydrylferrocene<sup>12</sup> directly from benzhydrylcyclopentadiene and also starting from diacetyl ferrocene has provided proof that both rings are substituted in the diacetylation of ferrocene. Ferrocene<sup>14</sup> and also ferricinium<sup>15</sup> salts undergo direct arylation when treated with diazonium salts. Both mono- and polyarylated ferrocenes are formed.

The formation of compounds analogous to ferrocene seems to be a general property of transitional elements which have two vacant

or singly occupied *d* orbitals that can be used in bonding. These compounds are of the type  $[(\text{C}_5\text{H}_5)_2\text{Mn}]\text{X}_{n-2}$  where *n* represents the oxidation state of the metal M and X is a uninegative ion. Derivatives of  $\text{Sc}^{16a}$ ,  $\text{Ti}^{21,16b}$ ,  $\text{V}^{21,16b,25}$ ,  $\text{Cr}^{17}$ ,  $\text{Mn}^{18}$ ,  $\text{Co}^{3,9,20}$ ,  $\text{Ni}^{3,21,12}$ ,  $\text{Y}^{16a}$ ,  $\text{Zr}^{21,16b}$ ,  $\text{Nb}^{16b}$ ,  $\text{Ru}^{23}$ ,  $\text{Rh}^{24}$ ,  $\text{La}^{16a}$ ,  $\text{Ce}^{16b}$ ,  $\text{Ta}^{16b}$ , and  $\text{Ir}^{24}$  have so far been reported. Two cyclopentadienyl compounds of Mn exist of which one seems to have a sandwich type structure like ferrocene and the other a metal alkyl structure like diethyl zinc. A magnesium derivative<sup>18</sup> of cyclopentadiene is also known and behaves as a metal alkyl.

These compounds are in general prepared either by reacting a metal halide or a metal acetylacetonate with cyclopentadiene magnesium bromide or by the vapour phase reaction of cyclopentadiene with a metal carbonyl. An elegant variation of the former procedure involves the reaction<sup>20</sup> in liquid ammonia between an alkali metal salt of cyclopentadiene and the appropriate metal amine salt followed by removal of ammonia *in vacuo*, e.g.,



Another variation<sup>18</sup> of the same method is to react sodium cyclopentadiene with a metal halide in tetrahydrofuran medium.

The similarity of the structures of  $\text{Co}(\text{C}_5\text{H}_5)_2$  and  $\text{Ni}(\text{C}_5\text{H}_5)_2$  to that of ferrocene has been confirmed<sup>20</sup> by X-ray diffraction studies. The infra-red and ultra-violet absorption spectra of the  $\text{Ru}^{23}$  and  $\text{Ni}^{13}$  compounds are similar to those of ferrocene. The magnetic susceptibilities of the Co and Ni compounds have been measured.<sup>3</sup> Many of these compounds are easily oxidised to the corresponding uninoctive cations, e.g.,  $\text{Ni}(\text{C}_5\text{H}_5)_2$  to  $[\text{Ni}(\text{C}_5\text{H}_5)_2]^+$ . The polarographic behaviour<sup>26</sup> of ferrocene and other biscyclopentadienyl compounds has been studied. The mass spectra<sup>27</sup> of a series of neutral biscyclopentadienyl compounds have been investigated recently with a view to correlate the spectra with molecular structure. Recently, the first representative of a biscyclopentadienyl metal carbonyl has been reported.<sup>28</sup>

As regards the electronic structure of ferrocene, a simple ten-bonded structure is excluded since only 18 electrons are available, 5 from each of the two cyclopentadienyl units and 8 from the iron atom. In proposing the structure IV for ferrocene, Woodward *et al.*<sup>4</sup> suggested that the iron atom could attain the configuration of the inert gas krypton by

utilising these 18 electrons. The filling of vacant metal orbitals in this manner is now regarded unlikely in view of the aromatic character of ferrocene which indicates that the  $\pi$  electrons are not appreciably withdrawn from the rings. Furthermore, the formation of cyclopentadienyl derivatives of transitional elements like Ti, Zr, V, etc., where sufficient electrons are not available for completion of the configuration of krypton, cannot be explained on the basis of such a view. The type of bonding involved in ferrocene and other biscyclopentadienyl compounds has been interpreted by molecular orbital methods by Jaffé,<sup>29</sup> Dunitz and Orgel<sup>6,31</sup> and Moffitt.<sup>30</sup> According to Moffitt, the structures of these compounds involve a primary two electron bond between each ring and the metal atom and a mixing and splitting of the  $3d^2_z$  and  $4s$  orbitals of the metal atom under the influence of the field of the  $\pi$  electrons of the cyclopentadienyl rings. In the compounds there are four  $d$  orbitals of the metal atom at approximately the same energy as the unperturbed  $d$  orbitals, two of which are used for metal to ring bonding and two  $ds$  hybrid orbitals, one below these four  $d$  orbitals and one above at about the level of the  $4p$  orbitals. The magnetic properties of many of the biscyclopentadienyl compounds have been explained in terms of such structures.

1. Kealy, T. J. and Pauson, P. L., *Nature*, 1951, **168**, 1039.
2. Miller, S. A., Tebboth, J. A. and Tremaine, J. F., *J. Chem. Soc.*, 1952, 632.
3. Wilkinson, G., Pauson, P. L. and Cotton, F. A., *J. Amer. Chem. Soc.*, 1954, **76**, 1970.
4. —, Rosenblum M., Whiting, M. C. and Woodward, R. B., *Ibid.*, 1952, **74**, 2124.
5. Eiland, P. F. and Pepinsky, R., *J. Amer. Chem. Soc.*, 1952, **74**, 4971.
6. Dunitz, J. D. and Orgel, L. E., *Nature*, 1953, **171**, 121.
7. Fischer, E. O. and Pfab, W., *Z. Naturforsch.*, 1952, **7B**, 377.
8. Woodward, R. B., Rosenblum, M. and Whiting, M. C., *J. Amer. Chem. Soc.*, 1952, **74**, 3458.
9. Weinmayr, V., *Ibid.*, 1955, **77**, 3009.
10. Kaplan, L., Kester, W. L. and Katz, J. J., *Ibid.*, 1952, **74**, 5531.
11. Cotton, F. A. and Wilkinson, G., *Ibid.*, 1952, **74**, 5764.
12. Pauson, P. L., *Ibid.*, 1954, **76**, 2187.
13. — and Wilkinson, G., *Ibid.*, 1954, **76**, 2024.
14. Broadhead, G. D. and Pauson, P. L., *J. Chem. Soc.*, 1955, 367.
15. Weinmayr, V., *J. Amer. Chem. Soc.*, 1955, **77**, 3012.
16. Wilkinson, G. and Birmingham, J. M., (a) *Ibid.*, 1954, **76**, 6210; (b) *Ibid.*, 4281.
17. Wilkinson, G., *Ibid.*, 1954, **76**, 209.
18. — and Cotton, F. A., *Chem and Ind.*, 1954, 307.
19. —, *J. Amer. Chem. Soc.*, 1952, **74**, 6148.
20. Fischer, E. O. and Jira, R., *Z. Naturforschung*, 1953, **8B**, (1), 217, 327.
21. Wilkinson, G., Pauson, P. L., Birmingham, J. M. and Cotton, F. A., *J. Amer. Chem. Soc.*, 1953, **75**, 1011.
22. Fischer, E. O. and Jira, R., *Z. Naturforschung*, 1953, **8B**, 217.
23. Wilkinson, G., *J. Amer. Chem. Soc.*, 1952, **74**, 6146.
24. Cotton, F. A., Whipple, R. O. and Wilkinson, G., *Ibid.*, 1953, **75**, 3586.
25. Fischer, E. O. and Hafner, W., *Z. Naturforsch.*, 1954, **9B**, 503.
26. Page, J. A. and Wilkinson, G., *J. Amer. Chem. Soc.*, 1952, **74**, 6149.
27. Friedman, L., Irsa, A. P. and Wilkinson, G., *Ibid.*, 1955, **77**, 3689.
28. Hallam, B. F. and Pauson, P. L., *Chem. and Ind.*, 1955, 652.
29. Jaffé, H. H., *J. Chem. Phys.*, 1953, **21**, 156.
30. Moffitt, W., *J. Amer. Chem. Soc.*, 1954, **76**, 3386.
31. Dunitz, J. D. and Orgel, L. E., *J. Chem. Phys.*, 1955, **23**, 954.

#### INDIAN SCIENCE CONGRESS, 1957

PROF. M. S. THACKER, Director, Council of Scientific and Industrial Research, has been elected General President of the Indian Science Congress for the year 1958.

Dr. B. C. Roy, Chief Minister, West Bengal, is General President for the 1957 session and the following are the Presidents of the different sessions: Prof. K. Chandrasekaran (Bombay—Mathematics); Dr. P. K. Bose (Calcutta—Statistics); Prof. K. R. Dixit (Ahmedabad—Physics); Dr. B. C. Roy (Calcutta—Geo-

logy and Geography); Prof. S. N. Das Gupta (Lucknow—Zoology and Entomology); Dr. M. N. Srinivas (Baroda—Anthropology and Archaeology); Dr. C. R. Das Gupta (Calcutta—Medical and Veterinary Sciences); Dr. E. S. Narayanan (New Delhi—Agricultural Sciences); Dr. Inderjit Singh (Agra—Physiology); Dr. S. M. Mohsin (Patna—Psychology and Educational Sciences); Prof. G. P. Chatterji (Howra—Engineering and Metallurgy).

## LETTERS TO THE EDITOR

	PAGE		PAGE
<i>A New Method of Measuring Ultrasonic Velocity in Solids</i> —GOPALA MENON, SREEKANTATH .. .. .	9	<i>Neurosecretory Cells in Calotes versicolor</i> —K. R. PANDALAI .. .. .	18
<i>Amperometric Estimation of Germanium</i> —A. P. MADHAVAN NAIR AND S. HAMSATH IBRAHIM .. .. .	10	<i>'Frontoparietal' Bone in Anura (Amphibia)</i> —L. S. RAMASWAMI .. .. .	19
<i>Influence of Light Intensity on the Characteristics of Non-Self-Maintained Region of a Low Frequency Electric Discharge</i> —B. D. KHOSLA .. .. .	11	<i>Trifidaphis gossypii sp. nov. (Fam. Aphididae), A New Species of Aphid Pest on Cotton in Bombay Karnatak</i> —H. L. KULKARNY .. .. .	21
<i>Broken Bonds in Kaolinite</i> —B. CHATTERJEE AND A. RAY .. .. .	12	<i>Colour as a Factor Influencing the Settlement of Barnacles</i> —A. DANIEL .. .. .	21
<i>Structure Pattern of Certain Granitic Bodies from Mysore</i> —M. R. SRINIVASA RAO .. .. .	13	<i>Control of Khapra (Trogoderma granarium Everts.)</i> —S. PRADHAN AND G. C. SHARMA .. .. .	22
<i>Preparation of Normal Ceric Hydroxide</i> —S. S. MOOSATH .. .. .	14	<i>On the Afferent Branchial Arteries in Mastacembelus armatus</i> —DEVENDRA B. SAXENA .. .. .	23
<i>Isolation of Hexachloroceric Acid</i> —S. S. MOOSATH AND M. R. A. RAO .. .. .	14	<i>Peculiar Mode of Origin of Polyovular Pollicles in Semnopithecus entellus</i> —HRISHI BHU TEWARI .. .. .	24
<i>Effect of Rauwolfia Alkaloids on Some Endocrine Functions</i> —M. SIRSI, R. RAMA RAO AND (MISS) M. INDIRA .. .. .	15	<i>Notes on the Germination of Turions in Hydrilla verticillata Presl.</i> —EVA MITRA .. .. .	25
<i>Microsporogenesis in Fimbristylis quinquangularis Kunth</i> —V. R. DNYANSAGAR AND D. K. TIWARI .. .. .	16	<i>Record of the Black Beetle, Phalacrus immarginatus Champ., Feeding on Sugarcane Smut</i> —R. A. AGARWAL .. .. .	26
<i>A Colorimetric Method for the Estimation of Butylated Hydroxyanisole in Fats</i> —K. KRISHNAMURTHY AND M. SWAMINATHAN .. .. .	16	<i>Effect of Hormones on Germination in Loquat Pollen</i> —N. N. DIKSHIT .. .. .	27
<i>The Effect of Frontal Section through the Hypothalamus on Respiration in Diencephalic Cats</i> —S. R. DASGUPTA .. .. .	17	<i>Permeability of the Vitelline Membrane of the Trout Egg</i> —DAYA KRISHNA .. .. .	28
		<i>A Dominant (Twin-bolled) 'Cluster' in Hirsutum Cotton</i> —N. R. BHAT AND C. T. PATEL .. .. .	29

### A NEW METHOD OF MEASURING ULTRASONIC VELOCITY IN SOLIDS

ACCORDING to Raman-Nath<sup>1</sup> theory of diffraction of light by ultrasonic waves in liquids, when a plane wavefront of light traverses in succession two ultrasonic fields of the same frequency, the diffraction pattern will have zero or minimum intensity when there is a phase difference  $\pi$  between the two ultrasonic fields. This principle is applied to find the ultrasonic velocity in solids.

A rectangular glass cell (Fig. 1) containing a liquid is traversed by an ultrasonic wave of frequency  $N$  produced by a quartz oscillator  $Q$ . In one half (A) of the cell is placed the solid in the form of a wedge C. Another similar wedge D of the solid is placed with the sloping

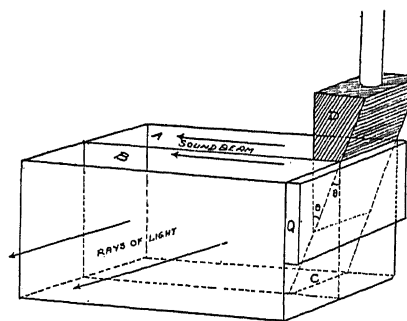


FIG. 1

edge parallel to that of the wedge C and can be moved up or down vertically by a fine calibrated micrometer screw. The two wedges

together form a rectangular slab of thickness  $d$ . In compartment A of the glass cell, the ultrasonic waves traverse first a thickness  $d$  of the solid with velocity  $V_2$  and thereafter the liquid with velocity  $V_1$ , while in compartment B the path of the waves lies entirely in the liquid. The phase difference between these two sets of waves will be  $\pi$ , if

$$d = V_2 (2n+1) \frac{\lambda}{2} / (V_2 - V_1),$$

where  $\lambda = V_1/N$ , and  $n$  is zero or an integer. Without the solid in A, the two waves will be in the same phase, and a parallel beam of monochromatic light from a narrow slit traversing the cell at right angles to the sound beam will exhibit a diffraction pattern, when viewed by a telescope. On introducing the

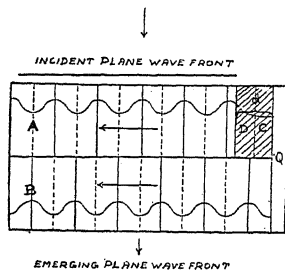


FIG. 2. The sine curves represent the sound waves in the two compartments.

solid (Fig. 2) the diffraction pattern will disappear when the phase difference between the two waves is an odd multiple of  $\pi$ .

The experiment consists in placing the glass cell on the prism table of a spectrometer and viewing the diffraction pattern through the telescope. The thickness  $d$  of the slab of solid traversed by the ultrasonic waves is varied by raising or lowering the wedge D very slowly, while observing the diffraction pattern. If  $X$  is the distance through which the wedge is raised between two successive minima  $d = X \tan \theta$ , where  $\theta$  is the angle of the wedge. This gives

$$X \tan \theta = V_1 V_2 / (V_2 - V_1) N.$$

Knowing  $V_1$ ,  $N$ ,  $X$  and  $\theta$ ,  $V_2$  is calculated.

The ultrasonic velocity in a specimen of ebonite measured by this method is given below, the liquid employed being water at 28° C. The angles of the wedges were 9° 26' and 9° 33', and the mean value  $\theta = 9^\circ 30'$  ( $\tan \theta = 0.1673$ ) was used in all the calculations. Two typical sets of measurements are given in Table I. The average value of  $X$  was found to be 0.425 cm. with a sample of ebonite, which yielded a value 2086 m/sec. for the ultrasonic velocity. The frequency used was 7.5 Mc/s. and  $V_1 = 1,500$  m/sec.

TABLE I

Positions corresponding to minima of intensity of Diffraction Pattern

	Moving up cm.	Moving down cm.	Mean cm.	X in cm.	
1)	4.520	4.561	4.540	0.415	0.429
	4.122	4.128	4.125	0.444	
	3.681	3.681	3.681		
2)	4.513	4.511	4.512	0.391	0.417
	4.121	4.121	4.121	0.444	
	3.677	3.677	3.677		

GOPALA MENON, SREEKANTATH.

University College,  
Travancore University,  
Trivandrum, November 19, 1955.

1. Raman, Sir C. V. and Nath, N. S. N., *Proc. Ind. Acad. Sci.*, 1935, 2A, 436-13.

### AMPEROMETRIC ESTIMATION OF GERMANIUM

AN accurate method of estimation of germanium by the amperometric technique has been developed. The method is based on the precipitation of divalent germanium as a complex with tannic acid, in an acid medium containing ammonium sulphate. The titration is carried out at  $-0.6$  V vs. SCE in presence of a little cresol red functioning as maxima suppressor. Temperature is without effect on the precipitation and on the titre values.

The value of the constant potential required for the amperometric titration was fixed after a study of the polarograms of divalent germanium. The half-wave potential obtained in an acid range of 0.25 to 0.35 N HCl and in presence of  $(\text{NH}_4)_2 \text{SO}_4$  (0.8 to 1.0 M) was  $-0.49$  V vs. SCE, working with a concentration of 4 millimoles/litre germanium. A constant potential of  $-0.6$  V vs. SCE which is well within the diffusion current plateau, was chosen for the amperometric titration.

The germanium solution used for the titrations was obtained by reducing a solution of 0.2 g. of pure  $\text{GeO}_2$  with sodium hypophosphite<sup>1</sup> and making it up to 100 ml. with HCl to give a final strength of 0.5 N. To known volumes (1-5 ml.) of a 6% tannic acid solution, a few drops of cresol red solution were added with a suitable volume of the solution of the supporting electrolyte [obtained by mixing equal volumes of 0.5 N HCl and 2 M  $(\text{NH}_4)_2 \text{SO}_4$ ] to give a total

volume of 25 ml. The standard germanous solution was added in 0.5 ml. increments. The diffusion current in microamps was read off from the charts obtained on a Tinsley model recording polarograph, the readings being taken 2 minutes after each addition of the germanous solution at a constant potential of  $-0.6$  V vs. SCE. The volumes of the germanous solution plotted against the current yielded straight lines, the intersection of which gives the end-point (Fig. 1).

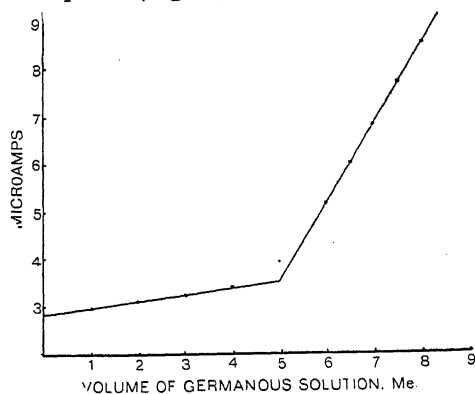


FIG. 1

TABLE I

Tannic acid ml. taken	Germanous solution titre value (from graph) ml.	Deviation ml.
1.00	1.67	0.005
2.00	3.35	0.00
3.00	5.02	0.005
3.50	5.85	0.012
4.00	6.70	0.000
5.00	8.40	0.025

The high accuracy of the method is evident from the data given in Table I, which contains the results of six different experiments. The maximum error is only of the order of 0.3%. It has also been found that arsenic does not interfere in this titration and that temperature has without effect on the precipitation of the complex and therefore on the titre value. It must however be mentioned that if the process of titration is reversed by adding tannic acid to germanous solution, reproducible results are not obtained.

Chemical Tech. Labs., A. P. MADHAVAN NAIR.  
C. College of S. HAMSATH IBRAHIM.  
Technology, Madras-25,  
November, 1955.

### INFLUENCE OF LIGHT INTENSITY ON THE CHARACTERISTICS OF NON- SELF-MAINTAINED REGION OF A LOW FREQUENCY ELECTRIC DISCHARGE

It has been reported earlier<sup>1-3</sup> that in a narrow potential region below the breakdown potential  $V_m$ , i.e., in the so-called non-self-maintained region, of a low frequency electric discharge in an electronegative gas or vapour enclosed in glass vessels, external radiation even in the visible range initiates the discharge; this is accompanied by the observation of certain current pulses on the oscillograph<sup>1</sup> and appreciable current flowing through the system. These exist so long as the external radiation is in operation. The variation with external light intensity of the rms value of the current  $i$  in the non-self-maintained region appeared contrary to general theoretical considerations (*vide infra*). The present communication reports a few interesting results on this aspect, which may be helpful for developing a mechanism for the abnormal behaviour of low frequency discharge with reference to external light intensity.

Cylindrical discharge tubes made out of soft soda glass and fitted with external sleeve electrodes were employed; these were similar to those used first by Wiedemann and Ebert.<sup>4</sup> They were filled with pure iodine vapour at a desired pressure and excited by 50 cycle potentials in the range 0.5-2 K.V. The rms value of the current flowing through the system was measured by a sensitive microammeter or a galvanometer suitably coupled with a crystal-rectifier 1 N 34. The details of the experimental technique have been given elsewhere.<sup>1</sup> Monochromatic radiations,  $\lambda = 4047, 4358$  and  $4916 \text{ \AA}$ , were obtained from a mercury arc lamp employed in conjunction with suitable Wratten filters; the radiations were used at different intensity values (1-400 in arbitrary units).

Fig. 1 gives a typical series of results on the variation with potential of the current initiated by  $\lambda = 4047 \text{ \AA}$  at different intensities ( $I = 65$  and  $365$ ). In the absence of the external light in the potential region from 95 to 200 volts/cm. the discharge was negligible; and the current passing through the system was inappreciable (curve 1, Fig. 1). When the discharge tube was illuminated, say, by  $\lambda = 4047 \text{ \AA}$ , appreciable current was recorded (curves 2 and 3, Fig. 1). This was observed, as mentioned above, as long as the radiation was on and disappeared when this was cut off, indicating the characteristic features of a non-self-maintained region (a-b, Fig. 1) of the

1. Everest, D. A., *J. Chem. Soc.*, 1953, 660.



discharge under investigation. Further, it was interesting to note from the data in Fig. 1 that with increase in intensity ( $I$ ) of light from  $I = 65$  to 365, the photo-current, curiously enough, decreased in its magnitude (cf. curves

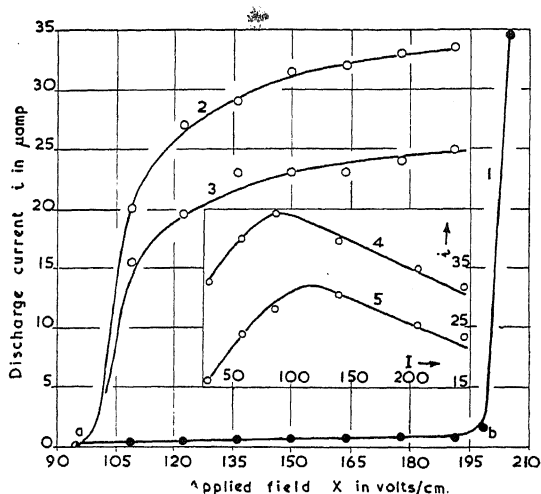


FIG. 1. Characteristic potential variation of the current in the non-self-maintained region of the low frequency electric discharge in iodine vapour. [Discharge tube .. D;  $p = 0.40$  mm Hg ( $28^\circ\text{C}.$ ); electrode separation 5 cm.] Curve 1 .. in dark; curves 2 and 3 .. under light ( $\lambda = 4047 \text{ \AA}$  at relative intensities 65 and 365 respectively).

The inset refers to the variation of current  $i$  with light intensity  $I$ . Discharge tube .. B;  $p = 0.45$  mm. Hg ( $30^\circ\text{C}.$ );  $X = 155$  volts (rms)/cm. Curve 4 .. electrode separation  $d = 5$  cm.; curve 5 ..  $d = 4$  cm.

2 and 3, Fig. 1). Contrary to this observation, theoretical considerations on photo- and thermo-electric effects and on electric discharge in gases show that increase in the intensity or the number of photons of the sensitive radiation should enhance the number of photo-electrons initiated into the system, which are responsible for the development of the so-called electron avalanches and the conductivity of the gas or vapour under applied fields.<sup>5,6</sup> Further, detailed investigations over a wide range of intensities showed that at a given applied potential, the photo-current  $i$  increased initially with rise of light intensity  $I$  to a maximum ( $I_m$ ) and then decreased with further increase in intensity (see inset, Fig. 1). It was remarkable that this value of  $I_m$  appeared to be a function of the applied field  $X$ . Thus the results in Fig. 2 show that  $\log I_m$  varies linearly with  $X$  for different electrode separations  $d$ . Furthermore, the plots  $\log I_m$  vs.  $X$  at various values of  $d$  are parallel to each other and have a negative slope. The results suggest that a relationship such as  $I_m = ae^{-bx}$  (where

$a$  and  $b$  are constants) is applicable to the features in the non-self-maintained region of the low frequency electric discharge in iodine vapour. Fuller details will appear elsewhere.

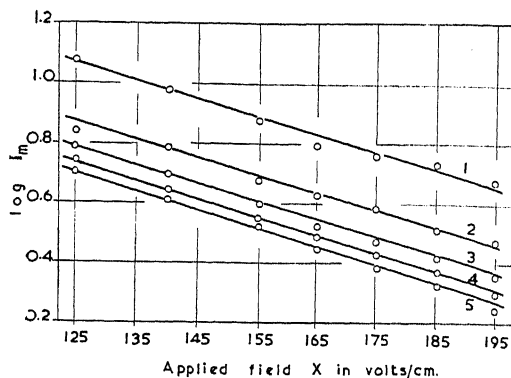


FIG. 2. Variation of  $\log I_m$  with applied field  $X$  at different electrode separations  $d = 3.5$  (1),  $3.75$  (2),  $4.0$  (3),  $4.25$  (4) and  $4.5$  cm. (5).

The author's thanks are due to Professor R. P. Mitra and Dr. N. A. Ramaiah for their interest and advice.

Chemistry Dept.,  
University of Delhi,  
Delhi, November 22, 1955.

B. D. KHOSLA.

1. Subrahmanyam, N. and Ramaiah, N. A., *Zeit. f. Physik*, 1953, **135**, 274.
2. Khosla, B. D., Gaur, H. C. and Ramaiah, N. A., *Curr. Sci.*, 1954, **23**, 399.
3. Ramaiah, N. A., Khosla, B. D. and Gaur, H. C., *J. Chem. Phys.*, 1955, **23**, 212; Khosla, B. D., *Ibid.*, 1955, **23**, 1373.
4. Wiedemann, E. and Ebert. *Wied. Ann.*, 1936, **1**, 221.
5. Loeb, L. B., *Fundamental Processes of Electric Discharge in Gases*, John Wiley, 1939.
6. Meek, J. M. and Craggs, J. D., *Electrical Breakdown of Gases*, Oxford, 1953.

### BROKEN BONDS IN KAOLINITE

THE existence or otherwise of 'broken bonds' in kaolinite as the seat of ion exchange is still an open question. Arguments have been put forward both in favour<sup>1,2</sup> and against<sup>3,4</sup> the 'broken bond' concept. The non-entry of anions like chloride, sulphate, nitrate, etc., in kaolinite from aqueous solutions by exchange has been put forward as a strong evidence against this hypothesis since the presence of 'broken bonds' in kaolinite should attribute an amphoteric character to this mineral. This argument does not however seem to be quite conclusive because even if anions are adsorbed at the 'broken bonds', they are liable to subsequent re-exchange for the hydroxyl ions present in

aqueous medium. Conclusive experimental evidence is therefore lacking to decide the issue. To eliminate the uncertainties arising out of this factor, studies have been made in the present work of the adsorption of potassium iodide in acetone in which potassium iodide is known to behave as a strong electrolyte.<sup>5</sup> The use of non-aqueous medium was expected to inhibit the re-exchange of adsorbed anions due to the factor discussed above. A dry sample of hydrogen-kaolinite, having a base exchange capacity of 3.90 milliequivalents (m.e.) per 100 g. of the mineral, was repeatedly leached with a solution of potassium iodide in acetone, the free potassium iodide was then washed off with dry acetone. Finally, the adsorbed cations and anions were displaced by leaching the 'treated' mineral first with water and then with a dilute solution of hydrochloric acid. The water extract was analysed (by conductometric titration against standard silver nitrate solution), for adsorbed iodide and the acid extract for adsorbed potassium following usual procedure. The amounts of iodide and potassium ions adsorbed by hydrogen-kaolinite sample used amounted respectively to 3.85 m.e. and 3.90 m.e. per 100 g. of the mineral. The adsorbed anions and cations are thus each equal to the base exchange capacity of the clay mineral. The amphoteric nature of kaolinite thus established may be taken to prove the presence of 'broken bonds' in kaolinite.

Bengal Engineering College, B. CHATTERJEE.  
Howrah, West Bengal, A. RAY.  
October 10, 1955.

1. Hofmann, U., Endell, K. and Wilm, D., *Zeit. Angew. Chem.*, 1934, **47**, 539.
2. Hendricks, S. B., *Ind. Eng. Chem.*, 1945, **37**, 625.
3. Kelley, W. P. and Jenny, H., *Soil Sci.*, 1936, **41**, 367.
4. Mitra, R. P., *Indian J. Physics*, 1948, **22**, 1929.
5. Bauer, F., *Ann. Physik.*, 1930, **6**, 253.

## STRUCTURE PATTERN OF CERTAIN GRANITIC BODIES FROM MYSORE

A DETAILED study of the structural pattern of certain granitic bodies in Mysore has been undertaken to investigate the possibilities of correlating the structure pattern with the method of igneous intrusion. Plutons of smaller dimensions offer themselves typically for such a study. One such pluton is situated S.-E. of Mysore known as Chamundi granite and is about 12 square miles in area, striking generally N.-E. and S.-W. consisting of coarse- to fine-grained pink and grey granites and is subsequently traversed by numerous dykes and veins of pegmatites and aplites. A careful in-

vestigation in the field as suggested by Cloos<sup>1</sup> and Balk<sup>2</sup> has revealed the presence of linear elements and fractures indicating a definite pattern.

The phenocrysts of orthoclase feldspar show a definite alignment at the contacts. The basic inclusions are usually long-drawn-out, often tapering at both ends, and their longer axes are generally parallel to one another. Nearly 230 readings were taken all over the pluton and the trend of flow lines suggest a regular pattern as indicated by the generalised direction of the flow lines in the accompanying map (Fig. 1).



FIG. 1. Structure map of Chamundi Granite showing the linear elements. The arrows indicate the generalised flow-lines. (Scale 1" = 1½ miles.)

The fracture pattern reveals two distinct and well-developed joints, 'Q' joints always occurring at 90° to the flow lines, and 'L' joints always occurring parallel to the flow lines. There are also 'D' joints occurring at 45° to both 'Q' and 'L' joints. Many of these fractures are filled up by pegmatites, aplites and quartz. They have developed so systematically that they form very conspicuous features from a distance.

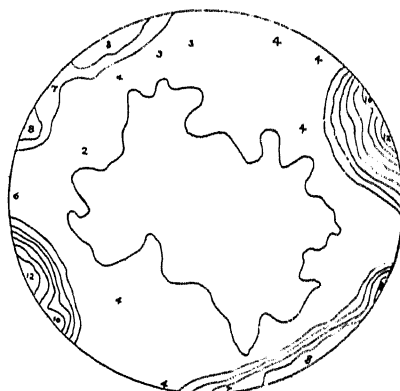


FIG. 2. Orientation diagram for the pitch of 102 fractures in Chamundi Granite. The pattern discloses two prominent systems, one showing a maximum of 7 to 8% pitching generally NW & SE, and the other showing a maximum of 10 to 12% pitching generally NE & SW.

The direction of pitch of 102 fractures have been plotted in the accompanying orientation diagram as suggested by Billings<sup>3</sup> (Fig. 2) and it is very interesting to note that a definite pattern is indicated. Further, there is a constant relationship between these fractures and the flow elements. Detailed discussion will be published elsewhere.

Central College, M. R. SRINIVASA RAO.  
Bangalore, November 10, 1955.

1. Cloos, E., *Maryland Geological Survey Report*, 1937, 13.
2. Balk, R., *Structural Behaviour of Igneous Rocks*, Edwards Ann. Arbor, 1948.
3. Billings. *Structural Geology*, Pitman and Sons, 1952.

### PREPARATION OF NORMAL CERIC HYDROXIDE

THE existence of normal ceric hydroxide  $\text{Ce}(\text{OH})_4$  or  $\text{CeO}_2 \cdot 2\text{H}_2\text{O}$  has not been reported except by Carnelly and Walker,<sup>1</sup> who studied the dehydration of wet ceric hydroxide at various temperatures and found a definite hydrate  $\text{CeO}_2 \cdot 2\text{H}_2\text{O}$ , stable up to 600° C. Hopkins,<sup>2</sup> on the other hand, describes a compound of the formula  $2\text{CeO}_2 \cdot 3\text{H}_2\text{O}$  obtained by adding ammonium hydroxide to ceric ammonium nitrate solution. According to Wyronboof and Vernuil<sup>3</sup> the violet layer formed by exposure of cerous hydroxide to air is cero-ceric hydroxide. Spencer<sup>4</sup> observes that oxidation of cerous hydroxide, in presence of alkali carbonates, takes place forming hydrated ceric peroxide. Although ceric oxide can be obtained by other methods,<sup>5,6</sup> it is difficult to establish its composition because of other co-precipitated materials. Several workers<sup>7-9</sup> have tried to elucidate the mechanism of oxidation of cerous hydroxide.

A systematic study of the preparation and properties of the oxidation product of cerous hydroxide, made in this laboratory, has resulted in developing a simple method for obtaining normal ceric hydroxide  $\text{Ce}(\text{OH})_4$  or  $\text{CeO}_2 \cdot 2\text{H}_2\text{O}$ . Cerous hydroxide, precipitated from a mixture of pure cerous nitrate solution and ammonium hydroxide, was oxidised with hydrogen peroxide and left overnight. The pale yellow precipitate was filtered off and washed free of soluble impurities, pressed between folds of filter-paper and then washed twice with dioxan by decantation and filtered. Washing with dioxan was continued several times on the filter. It was then washed with pure dry petroleum ether (30-75° C.) and dried in a current of dry-air free from carbon dioxide

when a dry, free-flowing yellow powder was obtained. A known weight of the powder was ignited to estimate the water content. The analytical results showed that the product corresponded with the formula  $\text{Ce}(\text{OH})_4$  or  $\text{CeO}_2 \cdot 2\text{H}_2\text{O}$ . Similar results were also obtained when absolute alcohol and dry ether were used as wash liquids.

Details will be published shortly. The author is thankful to Prof. K. R. Krishnaswami, for his interest in this investigation.

General Chemistry Dept., S. S. MOOSATH.  
Indian Institute of Science,  
Bangalore-3, India,  
November 17, 1955.

1. Carnelly, T. and Walker, J., *J. Chem. Soc.*, 1888, 53, 59.
2. *Chemistry of the Less Familiar Elements*, Stipes Publishing Co., Illinois, 1939, Chapter 6, p. 6.
3. Wyronboof, P. G. and Vernuil, A., *Ann. Chim. Phys.*, 1906, 9, 289.
4. Spencer, J. F., *Metals of the Rare Earths*, London, 1919, p. 76.
5. Biltz, W. and Zimmermann, F., *Ber.*, 1907, 40, 4979.
6. Feigl, F., *Chemistry of Specific Selective and Sensitive Reactions*, New York, 1949, p. 289.
7. Lawson, A. and Balsen, E. W., *J. Chem. Soc.*, 1935, 362.
8. Evans, M. G. et al., *Quart. Rev.*, London, 1952, 195.
9. Vickery, R. C., *J. Soc. Chem. Ind.*, 1950, 69, 122.

### ISOLATION OF HEXACHLOROCERIC ACID

ATTEMPTS made so far, for the isolation of ceric chloride or the corresponding hexachloroceric acid have not succeeded.<sup>1</sup> The reasons for the marked instability of ceric halides have not been fully understood. Only the fluorides are known as normal salts of both cerous and ceric cerium.<sup>2-4</sup> Ceric chloride has not been isolated in the free state, although the dark red solution obtained when ceric hydroxide is dissolved in concentrated hydrochloric acid, is supposed to contain ceric chloride or hexachloroceric acid which decomposes rapidly with evolution of chlorine. Although neither the hexachloroceric acid nor a salt of this has been isolated from the aqueous solution, salts of organic bases have been isolated from non-aqueous solutions.<sup>5,6</sup> Koppel<sup>5</sup> was the first to recognise the role of moisture towards the instability of the compound and used anhydrous methyl alcohol for the reaction of dry ceric hydroxide and dry hydrogen chloride gas and obtained an orange-coloured solution from which he could not isolate the free acid or ceric chloride.

The work carried out in this laboratory has shown that it is possible to obtain crystals of

hexachloroceric acid with dioxan of crystallisation. Pure, dry, hydrated ceric oxide (10 g.) suspended in anhydrous dioxan (200 c.c.) was treated with dry hydrogen chloride gas for about 3 hours. The liquid quickly turned orange-red in colour and the temperature rose to about 50° C. After filtering off the pale-yellow residue, the solution was kept at 2-3° C. for 24 hours. Needle-shaped orange-red crystals separated out. They were filtered off, washed with a little dioxan and then with petroleum ether and dried in a current of dry air. Care was taken to exclude moisture during the above operations. The crystals on analysis were found to agree with the formula  $H_2CeCl_6 \cdot 4C_4H_8O_2$ . The pyridinium double salt was prepared from a solution of the crystals in methyl alcohol and was found to agree with the formula  $(C_5H_5N_2)H_2CeCl_6$ . The details of these studies and results of the studies on the physico-chemical properties of the crystals will be published elsewhere.

The authors are thankful to Prof. K. R. Krishnaswami for his keen interest and helpful discussion during the course of the work.

General Chem. Dept., S. S. MOOSATH.  
Indian Inst. of Science, M. R. A. RAO.  
Bangalore-3,  
November 17, 1955.

1. Sidgwick, N. V., *The Chemical Elements and Their Compounds*, Oxford University Press, 1950, **1**, p. 263.
2. Von Wartenberg, M., *Z. Anorg. Chem.*, 1950, **244**, 337.
3. Klem, V. W. and Henkel, P., *Ibid.*, 1934, **220**, 180.
4. Rimbach, E. and Kilian, H. E. C., *Annalen*, 1909, **368**, 101.
5. Koppl, J., *J. Anorg. Chem.*, 1898, **18**, 305.
6. Ki Stefano, E., *Ann. Chim. Applicata*, 1919, **12**, 130.

## EFFECT OF RAUWOLFIA ALKALOIDS ON SOME ENDOCRINE FUNCTIONS

THE elucidation of the mechanism of action of Rauwolfia alkaloids has revealed that crude total alkaloids (C.T.A.) possess both central depressant and peripheral adrenolytic action<sup>1,2</sup> and reserpine depresses the sympathetic regulating centres in the hypothalamus.<sup>3,4</sup> Hypothalamus is the basically important central mechanism regulating the trophic hormones from the anterior pituitary for the gonads. A close relationship has been shown to exist between the genital function and autonomic nervous system.<sup>5,6</sup>

Since C.T.A. depress the hypothalamus and cause autonomic imbalance, the influence of

this drug on the ovarian function has been studied and compared with that of reserpine which has no adrenolytic activity and has been shown to cause disturbance in normal oestrus cycle of rats.<sup>7</sup>

The effect of these crude alkaloids, prepared as previously described<sup>8</sup> and their mechanism of action has been investigated by the administration of C.T.A., reserpine and serum gonadotropin to normal, ovariectomised and to hormonally induced oestrus rats.

The results of all the above experiments indicate that both C.T.A. and reserpine cause a prolongation of the oestrus cycle, the di-oestrus phase being chiefly involved; C.T.A. has no oestrogenic action, does not interfere with the cornification produced by oestradiol benzoate, exerts a slight irritant action on vaginal epithelium; causes a reduction in weight of the ovaries and uteri and a slight degree of hypertrophy of the adrenals and atrophy of the thymus. The weight loss of the ovary and the prolongation of the oestrus cycle was not observed in rats treated with serum gonadotropin after C.T.A. administration.

These observations suggest that the disturbance in the oestrus cycle is due to a diminished follicular hormone secretion of the ovary as a result of the depressant action of the drug on the hypothalamus mediated through the hypothalamus pituitary-gonad triangle.

The detailed paper will be published elsewhere.

Our thanks are due to the Himalayan Drug Co. (Bombay), Ciba Pharmaceuticals (Basle) and Schering, A. G. (Berlin), for the supply of *Rauwolfia serpentina* (Benth), reserpine (Serpasil) and serum gonadotropic hormone (Priantin) respectively.

M. SIRSI.

Pharmacology Lab., R. RAMA RAO.  
Indian Inst. of Science, (MISS) M. INDIRA.  
Bangalore-3, October 30, 1955.

1. Chopra, R. N., Gupta, J. C. and Mukherji, B., *Ind. J. Med. Res.*, 1933, **21**, 261.
2. Shaw, C. N. and Sirsi, M., *J. Mys. Med. Asso.*, 1955, **20**, 15.
3. Bein, H. J., *Experientia*, 1953, **9**, 107.
4. Plummer, A. J., Earl, A., Scheneider, J. A., Trapold, J. and Barrett, W., *Ann. N.Y. Acad. Sci.*, 1954, **59**, 8.
5. Nordmeyer, K., *Zbl. Gynak.*, 1950, **72**, 897.
6. Willig, H., *Ibid.*, 1952, **74**, 2.
7. Gaunt, R., Renzi, A. A., Antonchak, Miller, G. T. and Gilman, M., *Ann. N.Y. Acad. Sci.*, 1954, **59**, 22.
8. Sirsi, M. and Tirunarayan, M. O., *Curr. Sci.*, 1955, **24**, 185.

### MICROSPOROGENESIS IN *FIMBRISTYLIS QUINQUANGULARIS* KUNTH.

THE microspore mother-cells in the anther-lobe undergo two simultaneous reduction divisions. No quadripartition of the mother-cell takes place and thus for a time being four free nuclei are found within the wall of the mother-cell. Out of these nuclei, one remains in the centre and becomes the functional microspore nucleus, the rest being pushed to one end of the mother-cell. The functional nucleus grows larger but the remaining nuclei retain their original size. Later, a distinct septum is formed separating the functional nucleus from the three non-functional nuclei. In *Fimbristylis cericea*,<sup>1</sup> Tanaka did not observe any clear septum formation between the functional nucleus and the three non-functional nuclei as well as septa formation between the latter, whereas our observations here show clear septa between the nuclei as in *Carex*<sup>2</sup> and *Scirpus*<sup>3</sup> observed by Tanka.

Occasionally, the non-functioning nuclei undergo a division but no wall is laid down between the daughter-nuclei. Prior to the division of the functional nucleus, all these nuclei degenerate and their separating walls are also dissolved and ultimately only one functional microspore is formed per mother-cell.

The authors are thankful to Shri U. Mukerjee for facilities.

Dept. of Botany,  
College of Science,  
Raipur, M.P.,  
October 6, 1955.

V. R. DNYANSAGAR.  
D. K. TIWARI.

1. Tanaka, N., *Bot. Mag.*, Tokyo, 1939, **53**, 480.
2. —, *Jap. J. Genet.*, 1939, **15**, 153.
3. —, *Cytologia*, 1940, **10**, 348.

### A COLORIMETRIC METHOD FOR THE ESTIMATION OF BUTYLATED HYDROXYANISOLE IN FATS

BUTYLATED hydroxyanisole (BHA) is extensively used as an antioxidant in the stabilization of lard and shortening.<sup>1</sup> It is therefore necessary to have a simple and accurate method for the quantitative determination of BHA added to fats and fatty foods. Mahon and Chapman<sup>2,3</sup> have recently published two methods for the estimation of this antioxidant using either  $\alpha\alpha'$ -dipyridyl or 2:6 dichloroquinonechlorimide as reagents. Both the methods suffer from the disadvantage that the reagents  $\alpha\alpha'$ -dipyridyl and 2:6 dichloroquinonechlorimide are costly and difficult to procure. In the present communication, a simple and inexpensive

method for the determination of BHA in fats is described. The principle of the method is based on the oxidation of the antioxidant by ferric sulphate and the reaction of the resulting ferrous sulphate with ferricyanide and measuring the blue colour of ferrous ferricyanide complex with a colorimeter. Methods based on the above principle have been described by other workers<sup>4-6</sup> for the estimation of tocopherol in oils.

The reagents required were prepared as follows: (a) Standard BHA solution (strong, 0.1 mg. per c.c.) was prepared by dissolving pure BHA in 72% alcohol, (b) Standard BHA solution (dilute, 8  $\mu$ g. per c.c.) was prepared freshly when required by suitably diluting the strong solution with 72% alcohol, (c) Ferric sulphate solution (0.5%) was prepared by dissolving 0.5 g. of ferric sulphate (A.R.) in 100 c.c. of 1-N sulphuric acid, (d) potassium ferricyanide solution (0.2%) was prepared by dissolving 0.2 g. of potassium ferricyanide (A.R.) in 100 c.c. of distilled water. All the solutions were preserved in a refrigerator. Alcohol, free from reducing substances, prepared according to the method of Kartha *et al.*,<sup>6</sup> was used in all the experiments.

In preliminary experiments, the optimum quantities of ferric sulphate and potassium ferricyanide solutions required to produce maximum colour with known quantities of standard BHA solution were determined. The procedure finally adopted for the colorimetric determination of BHA was as follows: Aliquots of the standard or unknown extract (containing about 4-30  $\mu$ g. of BHA) were pipetted out into test-tubes and diluted to a volume of 10 c.c. with 72% alcohol. 0.5 c.c. of potassium ferricyanide solution and 0.5 c.c. of ferric sulphate solution were added and mixed. The colour was allowed to develop in the dark for 15 minutes. The maximum intensity of colour was reached within 15 minutes after which it was found to be stable upto 1 hr. The intensity of the colour was measured in a Klett-Summerson photoelectric colorimeter using a 660 m $\mu$  filter. From the results obtained, it was found that a linear relationship existed between increasing quantities of BHA and intensity of blue colour of ferrous ferricyanide complex. It was also observed that the readings, in Klett-Summerson colorimeter for the same concentration of BHA, was greater by the present method than by the  $\alpha\alpha'$ -dipyridyl method.<sup>2</sup>

The recovery of BHA added to hydrogenated groundnut oil was also determined. The anti-

oxidant was extracted from the fat dissolved in petroleum ether using 72% alcohol according to the procedure of Mahon and Chapman.<sup>2</sup> BHA present in the extracts was determined by the method outlined above and the values compared with those obtained by  $\alpha\alpha'$ -dipyridyl method.<sup>2</sup> The results are given in Table I. The values for the recoveries of BHA, as estimated by the present method, agree well with those determined by dipyridyl method. It may be seen from the table that about 95% of BHA added to hydrogenated groundnut oil could be recovered.

TABLE I  
Recovery of the BHA added to hydrogenated groundnut oil

Amount of BHA added to fat (mg.)	Amount of BHA recovered by :	
	Present method (mg.)	$\alpha\alpha'$ -Dipyridyl method (mg.)
0	0	0
10	9.6	9.4
20	18.8	19.0
30	29.4	29.0
40	38.0	39.0

Further studies on the stability of added BHA during the storage of fats are in progress.

Our thanks are due to Dr. V. Subrahmanyam, Director of this Institute, for his keen interest in this investigation.

Central Food Tech.

Res. Inst., Mysore,  
August 30, 1955.

K. KRISHNAMURTHY.  
M. SWAMINATHAN.

1. Kraybill, H. R., Dugan, Jr. L. R., Beadle, B. W., Vibrans, F. C., Swartz, Ven., and Rezabek, H., *J. Amer. Oil Chem. Soc.*, 1949, **26**, 449.
2. Mahon, J. H. and Chapman, R. A., *Anal. Chem.*, 1951, **23**, 1116.
3. Mahon, J. H. and Chapman, R. A., *Ibid.*, 1951, **23**, 1119.
4. Meunier, P. and Yinot, A., *Ann. Chim. Appl. Roma.*, 1941, **23**, 145.
5. Ramachandran, K. and Rao, Y. V. S., *Curr. Sci.*, 1943, **12**, 147.
6. Kartha, A. R. S. Sethi, A. S. and Gulathi, K. C., *J. Sci. Industr. Res.*, 1954, **14B**, 107.

#### THE EFFECT OF FRONTAL SECTION THROUGH THE HYPOTHALAMUS ON RESPIRATION IN DIENCEPHALIC CATS

In an earlier communication<sup>1</sup> it was stated that during experiments with a view to prepare diencephalic cats it was noticed that approximately 20% of the animals (13 out of 64) exhibited very hurried and rather shallow respiration. These respiratory changes followed

soon after the frontal (coronal) section through the hypothalamus in decorticate cats; also that they were not seen to appear in decerebrate cats. This led to the consideration of the possibility of the frontal section being at a level whereby some polypnoëic centres were released from rostral inhibitory control.

In cats bilaterally decorticated under ether, frontal sections were made at different planes: (1) immediately in front, (2) further rostral, and (3) caudal to the optic chiasma. In another group no frontal section was made. 'Sham rage' developed in all the cats, but a very hurried and rather shallow respiration developed within 10-20 minutes only in cats belonging to group (1). In some of these polypnoëic animals of group (1) a second frontal section was made in front of the tuber cinereum which was immediately followed by a change in character and slowing in the rate of respiration.

Macroscopic examination of brain specimen, preserved in 10% formol saline, revealed that the frontal section had passed in group (1) within 1 mm. of the optic chiasma, in group (2) at least 6 mm. in front of the chiasma, and in group (3) [also in the second transection in group (1)], immediately in front or even through the tuber cinereum.

The existence of a hypothalamic polypnoëic centre has been suggested by Magoun *et al.*<sup>2</sup> and Houssay,<sup>3</sup> and it has been shown by various workers that certain cortical areas, viz., the posterior part of the orbital surface of the frontal lobes (area 13) and the cingulate gyrus (areas 23 and 24) were concerned with the control of respiration.<sup>4-7</sup> Stimulation of both of these areas have been followed by inhibition of respiration.<sup>3,7-9</sup>

The orbital and the cingulate areas have been shown to be connected, sometime directly, with the hypothalamus. Le Gros Clark and Mayer<sup>10</sup> have shown that fibres from the post-orbital cortex (areas 13) and also from area 6 pass down to the hypothalamus and are finally conveyed to their termination by way of the median forebrain bundle. They have also shown that these cortical areas project fibres either directly or by collaterals to the anterior hypothalamic areas, the dorso-medial hypothalamic nucleus and the periventricular arcuate nucleus. Thus an intimate connection between the hypothalamic nuclei and the cortical area specifically concerned with autonomic respiration is established.

A frontal section passing immediately in front of the optic chiasma as in group (1) of the experiments is most likely to sever all the efferent fibres from the post-orbital cortex,

including those that cross in the rostrum of the corpus callosum, and also the fibres sent directly or by collaterals to the anterior hypothalamic area; the anterior periventricular region will thus be released from a tonic inhibitory cortical influence, and a panting type of breathing will ensue.

When the section is made further rostrally as in group (2), neither the post-orbital areas nor the efferent fibres from these areas are likely to be severed and therefore no respiratory changes follow the transection.

A frontal section passing through the tuber cinereum as in group (3) and also after the second transection in group (1) removes completely the anterior periventricular region along with the area responsible for polypnoeic breathing and evidently therefore no panting type of breathing follows the transection.

In the group of experiments where no frontal section is made, these areas or the fibres therefrom are not affected at all. It shows moreover that the inhibitory control is primarily exerted most probably by the post-orbital cortex.

It is therefore suggested that, normally in intact animals an anterior periventricular hypothalamic tachypnoeic (polypnoeic) centre might be kept tonically inhibited by rostrally situated centres in the cerebral cortex which exert their inhibitory control through the corticohypothalamic fibres described above. The severance of these fibres removes the cortical control over this hypothetical centre. This may provide some plausible explanation of the present experimental findings.

Provincial Drug Control      S. R. DASGUPTA.  
Laboratory,

School of Tropical Medicine,  
Calcutta-12, September 13, 1955.

## NEUROSECRETORY CELLS IN *CALOTES VERSICOLOR*

SCHARRER,<sup>1</sup> in his studies of the neurosecretory system of the garter snake *Thamnophis* sp., described the hypothalamic neurosecretory system as being constituted by the nucleus paraventricularis and the nucleus supra-opticus. The cells of these nuclei function as secretory centres which elaborate a stainable material, which passes along the axons and is stored in the neural hypophysis and in the base of the paraphysis. Recently, Ananthanarayanan,<sup>2</sup> working on certain South Indian reptiles, verified Scharrer's observations and went further to describe concentrations of nerve cells with very prominent cytoplasmic content in the midbrain in relation to the iter and also in the medulla oblongata. He suggested that these mesencephalic and medullary cells may have a neurosecretory function.

In the course of a study of the responses of the neurosecretory cells to various types of stress in the garden lizard, genus *Calotes*, the following facts have been incidentally noted.

The animals were killed either by decapitation or with an overdose of chloroform. Care was taken to minimise, as far as possible, the occurrence of non-specific stress, which, in the mammalian neurosecretory system, has been shown to produce profound changes.<sup>3</sup> The brain and spinal cord were removed and fixed in Bouin's or Helly's fluid or in 10% formol, and sectioned at 6-7  $\mu$  thickness. The staining methods employed included Gomori's chrome alum-haematoxylin phloxin; Gomori's aldehyde-fuchsin; Matsuura's phosphotungstic acid-Congo-red and thionin for Nissl material. Of these, Gomori's chrome alum-haematoxylin phloxin method proved to be the most reliable and useful one.

The supra-optic and paraventricular nuclei consist of large, globular or spindle-shaped neurones which take a remarkably intense stain with Gomori's chrome alum-haematoxylin phloxin method. These cells have large spherical nuclei, which may have a central or eccentric situation in the cell (Figs. 1 and 2). The nucleoli, often paired, are large and highly phloxinophilic. The cytoplasm is dense, homogeneous and stains a deep blue to blue-black with Gomori's chrome haematoxylin method. The density and homogeneity depends on the structure of the intra-cytoplasmic granules. These granules, in the majority of cells, are extremely fine and powdery, and are uniformly dispersed in the entire cytoplasm. The axons of these neurones have a beaded appearance.

1. Dasgupta, S. R. and Hausler, H. F., *Bull. Calcutta School Trop. Med.*, 1955, 3, 114.
2. Magoun, H. W., Harisson, F., Brobeck, J. R. and Ranson, S. W., *J. Neurophysiol.*, 1948, 1, 101.
3. Houssay, B. A., *Human Physiology*, New York, McGraw-Hill Book Co., Inc., 1951.
4. Smith, W. K., *J. Neurophysiol.*, 1938, 1, 55.
5. Bailey, P. and Bremer, F., *Ibid.*, 1928, 1, 405.
6. — and Sweet, W. H., *Ibid.*, 1940, 3, 276.
7. Sugar, O., Chusid, J. G. and French, J. D., *J. Neuropath. exper. Neurol.*, 1948, 7, 182.
8. Smith, W. K., *J. Neurophysiol.*, 1945, 8, 241.
9. Wright, S., *Applied Physiology*, London, Oxford University Press, 1952.
10. Clark, W. E., Le Gros and Meyer, M., *Brit. Med. Bull.*, 1950, 6, 341.

and can be traced from the cell body to greater or lesser extents towards their destination. Rarely cells containing two nuclei have been seen. The entire nuclear bed is very richly vascular.

toxylin method, are distinct from the neurosecretory cells in having medium-sized nuclei, large, coarse, rod-shaped cytoplasmic granules arranged parallel to the cell-surface and an absence of intra-axonal material which is

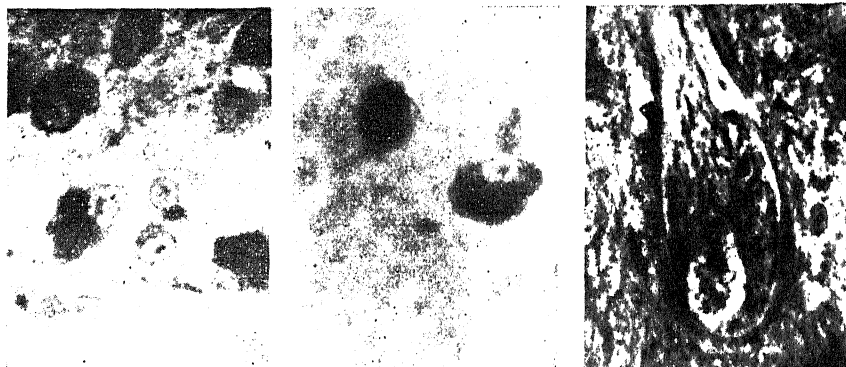


FIG. 1. Photomicrograph of cells of the nucleus supra-opticus of *Calotes versicolor*.

FIG. 2. Photomicrograph of cells of the nucleus para-ventricularis of *Calotes versicolor*.

FIG. 3. A cell from the medulla of *Calotes versicolor*.

The photomicrographs are from sagittal sections of the brain stained with Gomori's chrome alum-haematoxylin-phloxin method,  $\times 570$ .

Besides these neurosecretory cells in the hypothalamus, certain other neurones around the aqueduct, in the medulla and in the spinal cord, were also stained fairly deeply by all the methods used. These cells, however, differed from those of the nucleus supra-opticus and nucleus paraventricularis in their morphology and staining reactions. The neurones in the midbrain, medulla and spinal cord (Fig. 3) are generally large, spindle-shaped with medium-sized nuclei and large, coarse, rod-shaped material in the cytoplasm. Depending on the general intensity of staining these granules take a pale bluish violet to grey colour, with Gomori's chrome-haematoxylin method. The thionin preparations show that these intracytoplasmic bodies are merely clumps of Nissl material.

One of the most remarkable features of the cell aggregations in the hypothalamus is that not all their constituent cells have a similar appearance. Cells differ from each other in their size, position and staining qualities of the intracellular structures. Indeed, it may be said that no two cells look alike in this region. These differences, together with the abundance or paucity of the stainable cytoplasmic granules are an index of the varying phases of secretory activity of these cells. Such variations between the cells of a given "nucleus" have never been observed in any other part of the brain. Neurones in the medulla, though stained deeply with Gomori's chrome hæma-

Gomori positive. So the neurones in the mid-brain and medulla of the *Calotes versicolor* are different structurally from the neurones of the supra-optic and paraventricular regions, and probably are not neurosecretory in nature.

A detailed study of the neurosecretory mechanisms in *Calotes versicolor* is being carried out in this laboratory.

I am greatly indebted to Prof. V. Sitarama Rao, for his valuable guidance and keen interest.

Dept. of Anatomy, K. R. PANDALAI,  
Andhra Medical College,  
Visakhapatnam-1, November 1, 1955.

1. Scharrer, E., *Biol. Bull.*, 1951, **101**, 106.
2. Ananthanarayanan, V., *Curr. Sci.*, Feb. 1955, **24**, 60.
3. Pandalai, K. R. and Leveque, T. F., *Anat. Rec.*, 1953, **115**, 406.

#### 'FRONTOPARIETAL' BONE IN ANURA (AMPHIBIA)

GRIFFITH<sup>1</sup> in his study on the frontoparietal bones in Anura found that in the majority of ranid species examined by him, each half arose from two different centres. The posterior of these (parietal) grew both anteriorly and posteriorly and united with the frontal during its forward growth. The two frontoparietals later met in the midline. In the Discoglossid, Hylid, Pelobatid, Rhacophorid and Pipid



species examined by him, a frontoparietal was seen on either side and each arose from a single centre before it met its companion. In the other families examined by him, there was variance; some species showed a single centre while others exhibited two. He also pointed out in this connection that (p. 786), "In all the species in which the frontoparietal ossifies from a single centre, its pattern of development is similar to that of *Bufo marinus*". Of the Pipidæ, he examined only *Xenopus* tadpoles.

Griffith's above inquiry was prompted by the observation of Eaton<sup>2</sup> who considered the roofing bone in the orbitotemporal region in Anura as a frontal arising as it did from a single centre anteriorly in more than one species of frogs examined by him. Sedra<sup>3</sup> also came to the same conclusion confirming the observations of Eaton by adding to the list two more bufonid and a ranid species.

While examining the development of the chondro- and osteo-cranium of *Hemipipa carvalhoi* Mir.-Rib. (Pipidæ), I noticed that the development of the 'frontoparietal' conformed to neither of the above described methods. In a tadpole measuring 15 mm. (snout to vent, with small stumpy posterior limbs) the 'frontoparietal' has appeared in the form of a somewhat oval median ossification (Fig. 1). The

answering to bone by staining with Mallory in stages earlier than 15 mm.

In describing the frontoparietal of adult *Xenopus tropicalis*, Griffith<sup>1</sup> noted that the bones were fused in the middle and in another species *lævis*, Paterson<sup>4</sup> also noticed the appearance of frontoparietals as 'paired dorsolateral bones' which fused mesially only in the young frog. From the descriptions of Parker,<sup>5</sup> it could be made out that in *Pipa monstrosa* the frontoparietal arises from two centres, anterior, frontal and posterior parietal, and then the bones fuse in the young frog to form a single roofing bone by uniting in the middle line.

In *Hemipipa* on the other hand, the bone appears as a single median centre and it is very unlikely that the bone arises paired and then unites in the midline between the stages referred to above, for, in its other congeners, this fusion takes place only during or after metamorphosis. Further, in *Hemipipa* the bone does not show any feature of having arisen dually. Therefore, this appearance of a large median ossification extending over the orbitotemporal and occipitoauditory regions is really a case of developmental acceleration. In the older stages of *Hemipipa* examined (17 mm, snout to vent, four-limbed), the bone has extended on all sides.

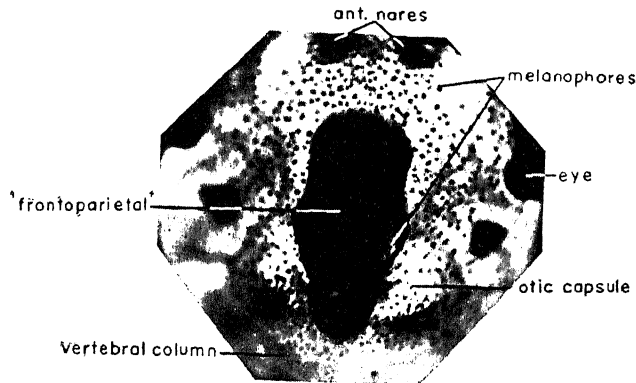


FIG. 1. Photograph of the dorsal view of a 15 mm. (snout to vent) long tadpole of *Hemipipa* showing the median 'frontoparietal',  $\times 5$ .

bone covers the large fontanel in this region and slightly expands in front of the otic capsules and then gradually narrows between them extending to in front of the vertebral column. I have examined as many duplicates available of the earlier stages as possible of this rare material and the alizarin transparencies of 13 mm. (snout to vent) tadpoles have not brought out the presence of any ossification. In sections also, I have not noticed any tissue

In a case like this, it would be exceedingly difficult to say whether the bone represents a frontal or a frontoparietal using the criteria employed by Griffith and Sedra.

I must express my sincere thanks to Mr. Antenor L. de Carvalho, for the gift of *Hemipipa* tadpoles made during our stay at Stanford University, California, and to Sri. M. Veerabhadriah, for taking the photograph. I am

particularly indebted to Prof. B. R. Seshachar, for helpful criticism.

Dept. of Zoology, L. S. RAMASWAMI.  
Central College, Bangalore,  
November, 1955.

1. Griffith, I., *Proc. Zool. Soc. Lond.*, 1954, **123**, 781.
2. Eaton, T. H., *Copeia*, 1939, 95; *J. Wash. Acad. Sci.*, 1942, **32**, 151.
3. Sedra, S. N., *Proc. Zool. Soc. Lond.*, 1949, **119**, 633.
4. Paterson, N. F., *Quart. J. Micr. Sci.*, 1939, **81**, 161.
5. Parker, W. K., *Phil. Trans. Roy. Soc.*, 1876, **166B**, 601.

**TRIFIDAPHIS GOSSYPHII, SP. NOV.**  
(FAM. APHIDIDAE),  
A NEW SPECIES OF APHID PEST ON  
COTTON IN BOMBAY KARNATAK

The genus *Trifidaphis* appears to be very poorly represented and its description as given by Theobald<sup>1</sup> is considered incomplete in many respects. It may be that so far very few species have been described under it. Theobald mentions only one species—*Trifidaphis phaseoli*, as having variable characters. According to him the genus is demarcated by the long second antennal segment. However, a new species with widely different characters has been recently collected by the author on the roots of cotton at Dharwar, Bombay State. Its description is given below with the object of fixing up the characters of the genus *Trifidaphis* in the first place, and secondly to record the new monotypic species *Trifidaphis gossypii*, sp. nov. collected by the author under the genus *Trifidaphis*. The complete description of the insect is to be published shortly.

*Trifidaphis gossypii*, sp. nov.

*Alate Viviparous Female*.—Average length  $2.36 \pm 0.02$  mm. Head: flat between the antennal bases with small short hairs on the vertex. Eyes: normal, fairly large. Antennal tubercles absent. Distance between bases of antennae measured 0.22 mm. Rostrum: reaching well beyond second coxae, chitinated apically with some short stiff hairs. Antennal segments: average length of first 0.064, second 0.096, third 0.256, fourth 0.096, fifth 0.160 and flagellum 0.160 mm. long. Segment three with 12-14 sensoria, segment four with 4-5 sensoria and fifth and sixth segments carry only the primary sensoria. Thorax: dark brown. Legs: mostly uniformly dark grey, average lengths of fore, mid and hind tibia measured 0.56, 0.64 and 0.83 mm. respectively. Fore wings: wing insertions pale yellow, stigma dark, cubitus is unbranched, the two discoidal veins originate

from a common point. Hind wings: normal. Abdomen: pale grey with median broad darker patches extending from first to last segment. Cornicles: absent. Cauda: little drawn out posteriorly, dark, rectangular, with some few hairs surrounding the caudal opening.

*Apterous Viviparous Female*.—Average length  $1.616 \pm 0.002$  mm., pale brown with a whitish mealy coat. Head: broadly convex between the bases of antennae which are 0.256 mm. apart. Eyes: with three facets only. Antennae: 5-6 segmented; average length of first 0.064, second 0.096, third 0.080, fourth 0.080, fifth 0.064 and flagellum measured 0.144 mm. Sensoria: only two primary sensoria, one on the apex of the fifth and the other at the apex of the base of the flagellum. Legs: pale yellow, uniformly covered over with short hairs; average length of fore, mid and hind tibia measured 0.272, 0.288 and 0.400 mm. respectively. Abdomen: pale, dusky brown with a small amount of mealy coat. Cornicles: absent. Cauda: same as in alatae. Host: heavy infestation on cotton plants was observed at Dharwar during January 1955.

Entomological Laboratory, H. L. KULKARNY.  
College of Agriculture, Dharwar,  
October 20, 1955.

1. Theobald, F. V., *The Plant Lice or Aphididae of Great Britain*, 1929, 3.

**COLOUR AS A FACTOR INFLUENCING  
THE SETTLEMENT OF BARNACLES**

The reaction of the larvae of marine fouling organisms to colour will be of commercial value in determining colours of anti-fouling paints. To study the influence of colour on the settlement of barnacles (a dominant member of the fouling complex at Madras) six glass plates of  $16" \times 10"$  which were coated with non-toxic paints of red, black, white, green, blue and grey and a seventh plate without any coating of paint were immersed at the New North Quay of the Madras Harbour. Similar sets of painted panels were immersed at four other sites in the main harbour and two sites in the boat basin.

The number of cyprid larvae of *Balanus amphitrite variegatus* settling on both the sides of these plates during 5-day periods at the different sites were counted. The experiment was repeated ten times throughout the year. Similar experiments were conducted for the larvae of *Balanus tintinnabulum tintinnabulum* and *Chthamalus stellatus stellatus* on the

TABLE I

Name of Species	Black	Red	White	Green	Blue	Grey	Plain glass plate (without colour)
<i>Balanus amphitrite variegatus</i>	.. 4250	3964	3318	1262	1761	1026	2829
<i>Balanus tintinnabulum tintinnabulum</i>	.. 3438	3492	3244	1033	1388	665	3291
<i>Chthamalus stellatus stellatus</i>	.. 4182	3206	3589	1369	1660	599	2141

Royapuram Shore. The data are averaged and presented in Table I.

A perusal of Table I shows that while red, black and white attracted large numbers, blue, green and grey plates had far fewer, grey panel being the poorest. Visscher,<sup>3</sup> Visscher and Luce,<sup>4</sup> Pomerat and Reiner,<sup>2</sup> and Weiss<sup>5</sup> found cyprids preferring dark background whereas in the present series of experiments, the numbers settling on white equalled those settling on black. Though the reaction of the cyprids to colour may lead us to a complex of several factors of behaviour involving the quantity of radiant energy absorbed or reflected<sup>3</sup> as well as the idiosyncrasies of the living organisms, it is felt that if grey or blue or green colours, which do not contrast against the background, are used in anti-fouling paints, it will have greater effect in successfully preventing settlement of larvæ of foulers for a longer period.

I am thankful to Dr. C. P. Gnanamuthu for suggesting the problem and help in the preparation of this paper.\*

University Zoology Lab.,  
Chepauk, Madras,  
November, 1955.

A. DANIEL.

\* This note forms a part of the thesis accepted for the Ph.D. degree of the University of Madras.

1. Daniel, A., *J. Madras Univ.*, 1955, **25B**, 97 and 189.
2. Pomerat, C. M. and Reiner, E. R., *Biol. Bull., Woods Hole*, 1942, **82**, 14.
3. Visscher, J. P., *Ibid.*, 1928, **54**, 327.
4. —, and Luce, R. H., *Ibid.*, 1928, **54**, 336.
5. Weiss, C. M., *Ibid.*, 1947, **93**, 14.

### CONTROL OF KHAPRA (*TROGODERMA GRANARIUM* EVERTS)

*Trogoderma granarium* Everts, is considered to be one of the most difficult enemies of foodgrains to control. The damage, however, is caused only in the larval stage. Hence the attention of most of the workers has so far been focussed on the larval stage. The larvæ feed on a large variety of grains, withstand long periods of starvation, live in foodgrain with very low moisture content and are in the habit of hiding in cracks and crevices. These special characters coupled with the extraordinary resist-

ance of these larvæ to practically all the insecticidal chemicals tried so far have led people to believe the prospects of its control to be quite gloomy. Lately queries for all available information about this pest have been received from several quarters including U.S.A., where this pest is spreading and is causing great concern.

Recently our studies on stored grain pests confirmed the unusual resistance<sup>1</sup> of Khapra larvæ to the contact toxicity of a number of modern insecticides but to our pleasant surprise it was observed in a preliminary experiment by one of the authors (S. P.) and S. S. Bhatia that some of these insecticides when mixed with wheat samples (DDT and toxaphene each at 83, 42 and 21 p.p.m. and gamma BHC, aldrin, dieldrin and chlordane each at 42, 21 and 10 p.p.m.) effectively checked the increase of infestation by this pest. This preliminary observation necessitated more detailed studies on the susceptibility of this species in stages other than the larval stage. Now it has been found that the resistance of the larval stage is lost even at the pupal stage, there being no emergence from a large percentage of pupæ kept on emulsion films (prepared from 1-2% emulsions) of lindane, aldrin and dieldrin. The adults that emerge are also quite susceptible to the films of these insecticides and also to those of DDT and toxaphene. Also the adults that emerge from pupæ sprayed with emulsions or kept on emulsion films of aldrin, dieldrin, toxaphene and lindane either do not lay eggs or lay a much reduced number of eggs, depending upon the concentration of the insecticide. Dusts and dust films are comparatively less effective. These studies have clearly indicated that these modern insecticides can be confidently used to disinfest godowns, to check the spread of, and to keep the grain meant for seed purposes safe from this otherwise dreaded pest. Details will be published elsewhere.

Division of Entomology, S. PRADHAN.  
Indian Agri. Res. Inst., G. C. SHARMA.  
New Delhi, November 2, 1955.

1. Pradhan, S., *et al.*, *Nature*, 1952, **170**, 619.

# ON THE AFFERENT BRANCHIAL ARTERIES IN *MASTACEMBELUS ARMATUS*

THE order Mastacembeliformes (Opisthomi) of Berg,<sup>1</sup> contains only one family Mastacembelidae which is represented in Uttar Pradesh only by the genera *Mastacembelus* and *Rhyncobdella*. The anatomy of these fishes is, therefore, both instructive and interesting, since they represent an entire order. Notwithstanding this, little published work on their morphology exists, except by Mitra and Ghosh<sup>2</sup> on the gross anatomy of the family Opisthomi. There are only two species of *Mastacembelus* which have been recorded from Uttar Pradesh, viz., *M. armatus* and *M. pancalus*. Although a good deal of work has been done on the true eels (Anguilliformes or Apodes), very little attention has been paid to the spiny eels which are found abundantly in India. Wu, Yih and Chang<sup>3</sup> have reported aerial respiration in *M. aculeatus*, a Chinese species, but they have not worked out the circulation of blood in the respiratory region of the fish.

The present work appears to be the first detailed account of the afferent branchial arteries in *Mastacembelus armatus* Lecepede (Actinopterygii; Mastacembeliformes; Mastacembelidae). The ventral aorta in this fish extends from the pectoral girdle up to the ventral end of the first branchial arch, where it terminates by dividing into the first pair of afferent arteries. The ventral aorta expands to form a sinus-like structure (Fig. 1)

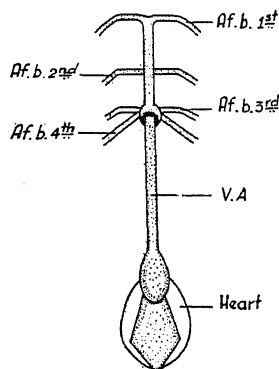


FIG. 1. Afferent branchial arteries in *Mastacembelus armatus*, Af. b. 1st—Af. b. 4th—Afferent branchial arteries 1-4; V.A. - Ventral aorta, which gives out two pairs of afferent arteries, the third and fourth. In between the third and first pair of afferent arteries, the second pair of afferent arteries is given off in level with the ventral end of the second branchial arch.

Each of the second pair of afferent arteries have a separate origin (Fig. 2) from the late-

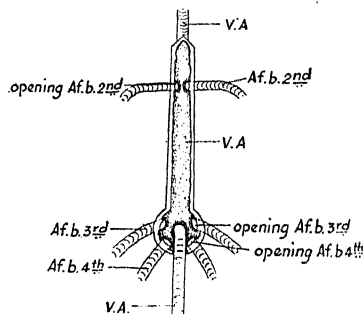


FIG. 2. A part of the ventral aorta cut open to expose the openings for the afferent arteries in *M. armatus*. Af.b. 2nd.—Af.b. 4th—Afferent branchial arteries 2-4; V.A. - Ventral aorta.

ral walls of the ventral aorta. The third and fourth pair of afferent arteries have their origin from the expanded portion of the ventral aorta. On exposing this region, four openings on the dorsal wall are observed, each leading to one of the four arteries. The four openings are closely situated, the openings of the third and fourth afferent arteries of each side being simply separated by a membranous partition. The third and fourth pairs of afferent arteries do not arise from the same aperture as observed by Mitra and Ghosh but each arises from a separate aperture of its own.

In the case of *Labeo rohita*,<sup>4</sup> all the four pairs of afferent arteries have separate origin from the lateral walls of the ventral aorta. In *Ophicephalus striatus*,<sup>5</sup> the third and fourth pair of afferent arteries originate from a common aperture in the roof of ventral aorta. It appears that in *Mastacembelus armatus* an intermediate condition is present in which the opening of the third and fourth pairs of afferent arteries have come closer, but have not fused as in *Ophicephalus*. My sincere thanks are due to Dr. S. M. Das for his valuable guidance during the conduct of the work.

Dept. of Zoology, DEVENDRA B. SAXENA.  
The University, Lucknow,  
November 3, 1955.

1. Berg, L. S., *Classification of Fishes*, Michigan; Edwards, J. W., 1947, 495.
2. Mitra, B. K. and Ghosh, E. N., *Rec. Indian Mus.*, 1931, 33, 291.
3. Wu, H. W. Yih, P. L. and Chang, H. W., *Sinensia*, 1946, 17 (1/6), 11.
4. Das, S. M. and Saxena, D. B., *Copeia*, 1956, 1.
5. —, *Curr. Sci.*, 1954, 23, 127.

# PECULIAR MODE OF ORIGIN OF POLYOVULAR POLLICLES IN *SEMNOPIITHECUS ENTELLUS*

DURING studies on the cytoplasmic inclusions in the oogenesis of *Semnopithecus entellus* (the common Himalayan langur) interesting stages in the formation of polyovular follicles were observed.

In some cases simple partition walls are laid down in a primary developing oocyte which result in the formation of 3 or 4 daughter-oocytes. Later on, cell-walls are laid down and more follicular cells come to surround them. This is the simplest of the processes but in other cases unique and interesting features of the role of the follicular cells in the production of polyovular follicles have been observed. Initially few follicular cells come to surround a developing oocyte as a single layer. As the oocyte grows, these follicular cells invade the oocyte at certain spots and this process goes on till the follicular cells are successful in dividing the original oocyte into two daughter ones. Later on definite cell-walls are laid down and more follicular cells join up to form polyovular follicles.

The third process provides some interesting features, and has not been reported by previous workers. During the initial stages, follicular cells proliferate on one side to produce a bulging mass. Later on some of the central follicular cells of this bulging mass get dissolved out, which result in the appearance of a vacuole. This clear space goes on enlarging till it reaches the zona pellucida of the original oocyte. At this state, a portion of the zona pellucida, touching the clear space, gives way as a temporary phase and then there is free communication between the two which facilitates the transfer of protoplasmic and nuclear material from the primary oocyte to the developing oocyte. The appearance of the nucleus and cytoplasmic inclusions in the developing oocyte on the side adjacent to the primary oocyte leave little doubt that they must have come from the primary oocyte. Later on, the broken zona pellucida of the original oocyte gets repaired and simultaneously another cell-wall is laid down around the developing oocyte. All these stages are shown in Figs 1-4.

The resulting biovular follicle in which the ova are in mutual contact can be fitted easily in the polyovular follicle classified as Type II by Hartman. Such polyovular follicles with no sign of liquor folliculi have also been observed by workers like Van Beneden, Schulin, Bouin

and Schron. Polyovular follicles showing intervening granulosa cells (Type I) and egg-cells in linear arrangement (Type III) have not been observed in the present case.

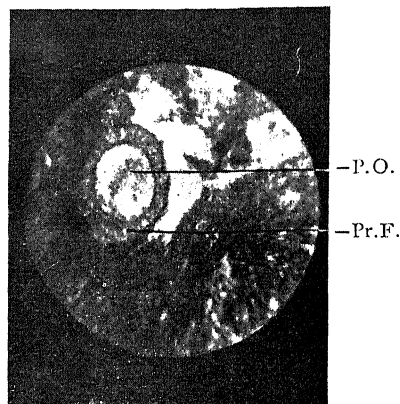


FIG. 1. Section showing primary oocyte (P.O.) and proliferation of follicular cells (Pr. F.) (Shridde method, iron-alum-haematoxylin),  $\times 125$ .

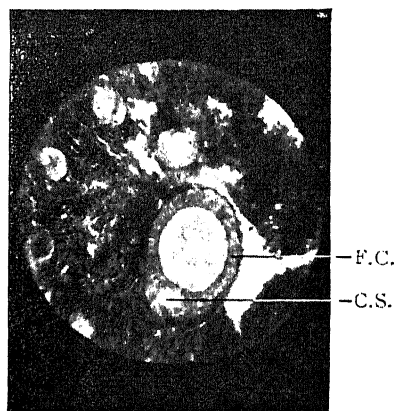


FIG. 2. Section showing appearance of clear space (C.S.) in the follicular cells (F.C.) of the primary oocyte (Shridde method, iron-alum-haematoxylin),  $\times 130$ .

Further, a distinction must be made between a typical development of ovum in an atretic follicle described by some workers and the present observations. In the former, amitotic fragmentation of the nucleus and division of the protoplasm occur within the zona pellucida of the oocyte and the resulting picture shows several bodies of varying size with distinct nuclei occurring in the interior of the zona pellucida which finally gets disorganised for its destruction. But, in the present observations, I do not find such a condition. On the contrary, a portion of the zona pellucida gives

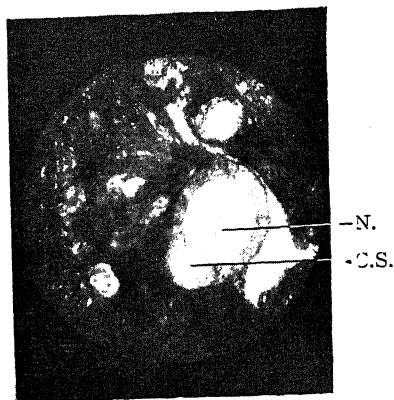


FIG. 3. Section showing the clear space (C.S.) touching the primary oocyte (Shridde method, iron-alum-haematoxylin),  $\times 125$ .

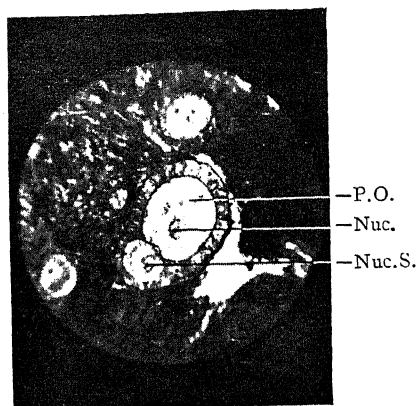


FIG. 4. Section showing the primary oocyte (P.O.) with the nucleus (Nuc.) and the secondary oocyte with the nucleus (Nuc.S.) enclosed by the follicular cells (Shridde method, iron-alum-haematoxylin),  $\times 125$ .

way temporarily for the transfer of the protoplasmic and the nuclear material to the developing oocyte. It soon gets organised and so in Fig. 4 we find two well-developed oocytes, enclosed by follicular cells, showing no sign of retrogression. Moreover there are no traces of fat droplets in these oocytes (appearing either as fatty vacuoles due to fat being easily washable by xylol or more resistant black osmicated fatty globules) even after the use of osmic acid, an important component of Shridde's fixative. So these observations are clearly demarcated from the phenomenon of atresia where the first sign of degeneration is marked with the appearance of fat droplets in the egg-cell as well as the shrinking and collapsing of the oocyte and the zona pellucida. Atresia is

a degenerating process whereas the present observations are of formative stages.

These observations are also important in focussing the attention on the role of the follicular cells in the production of polyovuly in the common "Himalayan Langur".

A detailed paper discussing the phenomenon of twinning in mammals will be published elsewhere.

Dept. of Zoology, HIRSHI BHU TEWARI.  
The University, Lucknow,  
July 28, 1955.

1. Maximow, A. A. and Bloom, W., *A Text-Book of Histology* (W. B. Saunders Co., Pa), 1948, 502.
  2. Hartman C. G., *Amer. J. Anat.*, 1926 **37**, 1.
  3. \*Van Beneden, *Archives de Biologie*, 1880, **1**.
  4. \*Bouin, P., *Compt. Rend. Soc. Biol.*, Paris, 1900, **5**.
- \* Originals not seen.

#### NOTES ON THE GERMINATION OF TURIONS IN *HYDRILLA VERTICILLATA* PRESL.

SEVERAL aquatic plants are known to develop 'winterbuds' or 'turions', to tide over adverse conditions during the winter months and to ensure vegetative propagation.<sup>1-3</sup> Two types of turions, namely, underground and floating, the former developing on the positively geotropic shoot tips of axillary branches and the latter in the shoot tips of axillary branches on the submerged parts of the stems much above the mud level have been recorded in *Hydrilla verticillata*.<sup>3</sup> The axillary branches, which bear the underground turions terminally, are generally long and are present nearer the mud level, so that just after their formation they bend, penetrate the soil and form the turions at their tips. The green turions appear axillary owing to their very short stalks. The morphology of the floating green turions has been described by the present author in an earlier contribution.<sup>4</sup> No account of the germination or autecology of either types of turions of *H. verticillata* appears to be on record.

While studying the autecology of *H. verticillata* in fishery waters at Cuttack, Orissa, observations were made on the different stages of germination of both the types of turions under natural conditions and also in earthenware tubs containing mud and water and a brief report of the same is given in this note. This study has some bearing on possible control measures of the plant which often quickly overgrows in fishery waters.

Ordinarily a larger number of underground turions are developed in a plant than the green turions. According to Lakshmanan,<sup>2</sup> both the

types of turions are of the same size but it is observed that in the fully formed condition the length of green ones range from 3-12 mm. and the underground turions are generally larger in size and usually measuring from 4-15 mm. in length. The other distinguishing characters of these two types of turions have been given by Lakshmanan.<sup>2</sup>

When fully formed, the green turions drop on the bottom mud and the underground ones also get detached from the plant. In experimental earthenware tubs the turions were observed germinating within 8-12 days after being detached from the plant.

When shed, the green turions are generally found in the surface layers of the bottom soil and they germinate into small plants which are generally characterised by very short internodes with green, whorled leaves and roots (Fig. 1, C). Rarely, more than one shoot may

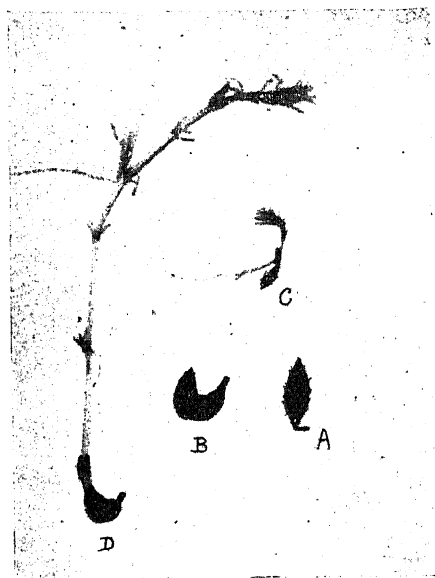


FIG. 1

- A—Mature green turion.  
B—Mature underground turion.  
C—Germinating green turion with short internodes, green leaves and typical roots.  
D—Germinating underground turion with long internodes and the roots developed at the point of emergence from the bottom mud.

also be seen coming out of a turion. The underground turions are found in the deeper layers of mud, even upto a depth of about 6-7". When the turions are buried deep, the germinating shoot elongates and bears long internodes and pale rudimentary leaves till it reaches the surface of the bottom mud (Fig. 1, D). Roots, which are adventitious, are also not ordinarily

formed till the germinating shoot protrudes from the bottom mud and develops green leaves. Once the germination commences, it takes only about 12-14 days for the formation of a fully developed plant.

Both the turions are present on the plant in abundance during the period December-January. Detached turions were observed from the end of April onwards. Large-scale shedding of both the types of turions from the parent plants was observed from the beginning of May to the end of June. Almost all the turions are shed by the end of this period. In natural ponds, germination commences from the middle of May. Newly germinated plants are abundant in the pond by the middle of June.

As far as the author could make out, a large percentage of the newly developed plants results from the germination of both the types of turions. Whether seeds, if any, also play a significant role in tiding over adverse conditions and in the propagation of the plant is under investigation.

I am indebted to Mr. K. H. Alikunhi for helpful suggestion in this study.

Central Inland Fisheries Research Station,  
Calcutta-7, November 22, 1955.

EVA MITRA.

1. Arber, A., *Water Plants*, Camb. Univ. Press, 1920, 219.
2. Lakshmanan, C., *J. Bom. Nat. Hist. Soc.*, 1951, 49 (4), 802.
3. Safeeulla, K. M. and Govindu, H. C., *Curr. Sci.*, 1949, 18 (ii), 414.
4. Mitra, Eva, *J. Asiatic Soc. Sci.* (in press).

#### RECORD OF THE BLACK BEETLE, *PHALACRUS IMMARGINATUS* CHAMP. FEEDING ON SUGARCANE SMUT

DURING August of this year, examination of smutted whips of sugarcane revealed the presence of a number of small holes in the membrane, and also of some black shining beetles which were briskly moving about. Subsequent studies showed that whitish grubs of different ages were concealed in the smut layer between the membrane and the columella of the smutted whip. As a result of their being embedded in the fertile layer, plenty of smut spores were seen attached to all parts of their body. Dissection of some of them showed the presence of spores (Fig. 1, A and B) in the alimentary system which suggested that the grubs feed on the spores. The spores collected from the alimentary canal appeared to be normal but failed to germinate when cultured artificially.



FIG. 1

FIG. 1. (A) A full grown grub (fore-intestine ruptured) with smut spores in the alimentary canal.

(B) 3rd instar grub with some spores attached to its dorso posterior parts of the body.

A study of the life-history of the beetle was also made under laboratory conditions. The eggs are whitish and oblong when freshly laid, but turn brownish on hatching, measure 0.5-0.75 mm. long and 0.2-0.28 mm. broad. Eggs take 7 or 8 days to hatch. The grubs, on hatching, move about actively for some time and then enter the whip by puncturing the silvery membrane and establish themselves in the smutted layer, where they feed on the smut spores till they are fully grown. The fully grown grub is white in colour measuring 5.0-5.5 mm. in length and 1.3-1.5 mm. in breadth with three pairs of prolegs. When nearing pupation, the grubs descend and lodge themselves at the transverse mark, i.e., at the junction of the leaf with the stem. They cease to feed, and remain quiescent for a time before pupating. The pupa is white in colour, 2.8-3.3 mm. long and 1.5-1.7 mm. broad, broader at the anterior end. The pupal period, as observed in the laboratory, varies from 8-9 days. The adults, when freshly emerged are brownish white and inactive, but turn into shining black beetles after some time. The adult is convex, 2.5-3.5 mm. long and 1.5-2.3 mm. broad. The antennæ are clavate and 11-segmented. Tarsus 4-jointed with a

pair of claws. The elytra covers the abdomen entirely.

This is presumably the first record of the occurrence of *Phalacrus immarginatus* Champ. on sugarcane smut. Grateful thanks are due to Shri N. L. Dutt for his guidance and encouragement. The author is indebted to Dr. M. L. Roonwal (Dehra Dun), for kindly identifying the insect.

Sugarcane Breeding Inst., R. A. AGARWAL.  
Coimbatore, October 10, 1955.

### EFFECT OF HORMONES ON GERMINATION IN LOQUAT POLLEN

IN the course of his studies on parthenocarp in loquat (*Eriobotrya japonica*) the author observed very poor setting in the flowers borne in the months of August and September. The production of pollen was also found to be poor in those months. It was therefore considered desirable to find if the germination of pollen and the elongation of the pollen tube could be accelerated with the help of growth substances.

The freshly-collected pollen were germinated in 1% sugar solution on cavity slides and, where necessary, the growth substances were applied in that medium. The slides were sealed with liquid paraffin, so that they could be easily opened and sealed. The germination of the pollen was allowed to continue only for 90 minutes and the observations were made at 30 minutes interval. In the end a drop of acetocarmine was introduced in the culture drop for staining and killing the tubes.

Germination of pollen was recorded by counting the total number of pollen in a field and then recording the number of germinated pollen in the same field. Figures in tables indicate the values obtained from observations in four fields. The length of the pollen tube was measured with the help of a standardised

#### I. EFFECT OF NAPHTHALENE ACETIC ACID

TABLE I

Effect of alpha naphthalene acetic acid on germination of pollen and the elongation of the pollen tube

Concentration P.p.m.	Time in mt. for germination	Percentage of germination	Length of pollen tube
0	67	32.5	3.07
5	68	36.3	3.32
10	67	26.0	2.97
15	90	7.2	..



ocular micrometer plate, and figures indicate mean of 30 values.

Figures in Table I indicate that 5 p.p.m. concentration is the best so far as germination and the length of pollen tube were concerned. The higher concentrations, *i.e.*, 10 and 15 p.p.m., were not so beneficial; the latter was actually toxic as in that treatment only 7.2% germination was observed after 90 minutes. In the lower concentration the germination started in 68 minutes.

## II. EFFECT OF BETA INDOLYL ACETIC ACID

TABLE II

*Effect of beta indolyl acetic acid on the germination of pollen and the elongation of the pollen tube*

Concentration p.p.m.	Time in mt. for germination	Percentage of germination	Length of the pollen tube
0	30	46.8	2.3
5	30	41.0	2.33
10	30	59.2	2.05
15	60	53.7	1.83
20	60	54.6	1.71
25	60	35.0	1.5

The germination started within 30 minutes in 0, 5 and 10 p.p.m. concentrations and within 60 minutes 15, 20 and 25 p.p.m. treatments. Highest percentage of germination was observed in 10 p.p.m., concentration beyond which there was a decline in the extent of stimulation. It was actually less than the control in the 25 p.p.m. treatment.

The growth of pollen tube showed a progressively adverse effect with the increase in concentration of the growth substance irrespective of the fact that some concentrations actually enhanced the percentage of germination (10, 15 and 20 p.p.m.). The figures in Table II suggest that treatment with growth substance has a tendency to arrest the elongation of the pollen tube. The findings are in line with those of Addicot<sup>1</sup> who suggested that the pollen germination and tube elongation are two distinct physiological processes requiring different factors. The shortage in the length of pollen tube may be due to the initial delay in the germination of pollen in higher concentrations. This aspect, however, needs further investigation.

My thanks are due to Dr. L. B. Singh for help during the work and to Dr. K. M. Aiyappa for kindly going through the manuscript.

Co-ordinated Scheme for N. N. DIKSHIT.

Research on Micronutrients,  
Gonikopal (S. Coorg), October 6, 1955.

## PERMEABILITY OF THE VITELLINE MEMBRANE OF THE TROUT EGG

DURING a study of the osmotic properties of trout egg, Gray<sup>1</sup> observed its vitelline membrane was impermeable to the surrounding water. Krogh and Ussing,<sup>2</sup> on the other hand, observed that a certain amount of water did get into the eggs through its vitelline membrane. It is now a matter of common observation that the eggs, as they come out of the female, are not round, but look like dried peas. They assume a round shape when they have stayed in water for 12 hr. or so. This shows that a certain amount of water has gone into the eggs from their surrounding. This water has passed not only through the chorion which is of course porous and admits water to allow aeration of the growing embryo, but also through the vitelline membrane to the yolk, because the yolk and the vitelline membrane have the shape of the chorion when the eggs

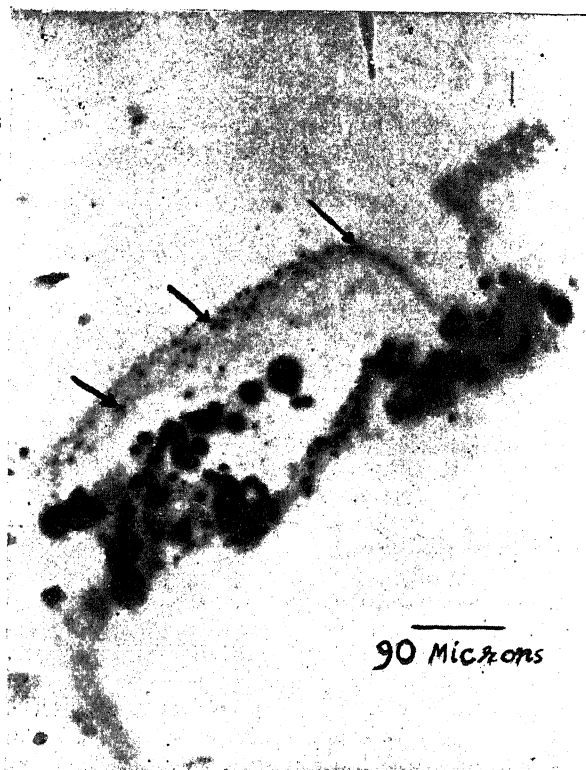


FIG. 1

Photo-micrograph of a part of a frozen section after its proteins have been removed with pepsin. The row of small dots (marked with arrows) indicates the lipoids of the vitelline membrane. The big dots indicate the lipoids on the surface of the yolk. *Fixative*: Calcium-formaldehyde. *Age of the egg*: Thirty hours after laying. Similar section of an egg just after laying does not show the droplets in the place of the vitelline membrane.

1. Addicot, F. T., *Plant Physiol.*, 1943, 18, 270.

are laid and become round with it when the eggs have remained in water overnight. It has also been observed that there are no movements in the vitelline membrane of the freshly-laid eggs. The rhythmical movements start when the eggs have stayed in water for some time.<sup>3</sup> The histo-chemical study of the vitelline membrane shows that it is mainly composed of proteins. In freshly-laid eggs the membrane has no lipoids attached to it and can be completely digested by the protein-digesting enzymes, like pepsin. But the vitelline membrane of the eggs which have stayed in water overnight or more carries a certain amount of lipoids. When it has been digested there are left in its place certain tiny droplets of the lipoids (Fig. 1).

It seems to be a probable explanation of the contradictory findings of Krogh and Ussing, and Gray that the former studied green ova and the latter took advanced eggs for his experiments. When the eggs are laid, there are no lipoids attached to the vitelline membrane and it allows a certain amount of water to get into the yolk. Later on rhythmical movements start in the membrane; and it rubs against the yolk and gets soaked in the lipoids present on the yolk surface in the form of oil droplets and becomes impermeable to water.

Dept. of Zoology, DAYA KRISHNA.  
Jaswant College, Jodhpur,  
October 26, 1955.

1. Gray, J., *J. Exp. Biol.*, 1932, **9**, 277.
2. Krogh, A. and Ussing, H. H., *Ibid.*, 1937, **14**, 35.
3. Rothschild, Lord, Personal Communication.

### A DOMINANT (TWIN-BOLLED) 'CLUSTER' IN HIRSUTUM COTTON

THE cluster habit, responsible for the production of two or more bolls at sympodial nodes, has been considered to be recessive in literature on cotton.<sup>1,2</sup> However, the twin-bolled segregate described below was found to behave as a recessive as well as a dominant in segregations.

The cluster segregates occurred in the cross, (Co<sub>2</sub> × Pima)F<sub>1</sub> × B.C. 68 from the very first segregating generation, but their counts were first taken in three F<sub>6</sub> cultures grown in 1953-54. Study of the segregations was followed up in 1954-55. The data are presented in Table I.

TABLE I  
Showing cultures derived from normal plants

Culture No.	Normal	Cluster	Total
<b>F<sub>6</sub> cultures</b>			
2442	10	5	15
2452	21	4	25
2489	10	5	15
<b>F<sub>7</sub> Cultures</b>			
2442 <sup>a</sup> -2085	39	7	46
-2086	15	3	18
-2089	19	2	21
-2094	6	15	21
2452 <sup>b</sup> -2102	19	9	28
2489 <sup>c</sup> -2113	17	5	22
-2116	1	8	9
-2117	10	2	12
<b>Cultures derived from cluster plants</b>			
2449 -2081	2	8	10
2442 <sup>d</sup> -2088	1	9	10
2489 -2118	5	3	8
-2119	2	8	10
	10	28	38

<sup>a</sup>—Two cultures from this family did not segregate; <sup>b</sup>—Seven cultures from this family did not segregate; <sup>c</sup>—One culture from this family did not segregate; <sup>d</sup>—One culture from this family did not segregate.

It will be seen from the data in Table I that while cluster segregates have occurred in cultures derived from normal plants, cluster cultures have thrown normal segregates. This would indicate that cluster in this case is dominant to normal but, when in association with an inhibitor, as seems to have happened in the F<sub>6</sub> cultures, 2442, 2452 and 2489 and certain of their derivatives, its expression is also modified to normal. Such a conclusion is inevitable, though plant numbers in the above-mentioned cultures are too small to prove that the ratio, normal:cluster is 13:3 and not 3:1. It is further confirmed by the fact that the 3 and 7 plants which resulted respectively from the crosses, (i) 2494-6 (cluster) × 2442-5 (normal), and (ii) 2494-8 (cluster) × 263-1 (normal) were of 'cluster' habit.

Agri. Res. Station,  
Surat, November 1955.

N. R. BHAT.\*  
C. T. PATEL.

\* Present Address:—Central Tobacco Research Institute, Rajahmundry.

1. Harland, S. C., *The Genetics of Cotton*, 1939. Jonathan Cape, London.
2. Bhat, N. R. and Desai, N. D., *Proc. Ind. Sci. Congress*, 1955.

---



---

## REVIEWS

---



---

**X-Ray Diffraction in Polycrystalline Materials.**

Edited by H. S. Peiser, H. P. Rooksby and A. J. C. Wilson. (The Institute of Physics, London), 1955. Pp. 725. Price 63 sh.

Several books are available on X-ray crystallography but none of them deal in any detail with the study of powder specimens. The book under review is therefore particularly welcome, since it contains in a single volume the scattered information on this subject available only in various journals.

Some 30 different authors, mostly drawn from Great Britain, have contributed the 32 chapters in the book, which is divided into three parts. The first part deals with experimental methods. After an introductory account of the principles of X-ray diffraction and of X-ray generators and methods of film measurement by the editors, detailed accounts are given of the use of the standard Debye-Scherrer camera, focussing cameras, back-reflection and low-angle cameras, special methods for high and low temperatures and methods for studying preferred orientation. There is also an excellent chapter on Counter Diffractometers, dealing with the use of Geiger counters, proportional counters and scintillation counters.

Part II is concerned with the interpretation of the diffraction data. The special topics considered are the determination of the unit cell, precision determination of lattice parameters, measurement of intensity of the lines and of line profiles and scattering by non-crystalline media such as proteins. The use of this technique for identification of materials is discussed in a separate chapter, while two chapters are devoted to the preferred orientation of metals and fibrous materials, and the effect of this on the X-ray pattern.

Part III deals with applications. A wide variety of topics is covered, such as the use of the powder method in an industrial laboratory, in mineralogical research, for the study of proteins and high polymers, in ceramic research, in metallurgy and in researches associated with atomic energy. The volume concludes with a chapter on the properties of X-ray films and the technique of photographic photometry. A. J. C. Wilson has contributed a series of most useful appendices, containing tables of data often required in these studies.

Extensive references to the original literature is given throughout the book. The editors must be congratulated on the way in which they have welded the various articles together. The volume is sure to be appreciated by every X-ray crystallographer and industrial physicist.

G. N. RAMACHANDRAN.

**An Introduction to Reactor Physics.** By D. J. Littler and J. F. Raffle. (Pergamon Press, Ltd., London), 1955. Pp. viii + 196. Price 25 sh.

In the past few years, rapid progress has been made in the field of reactor physics. Several monographs and books have been written on this subject notably Soodak and Campbell's "Elementary Pile Theory", the MIT volumes and "The Elements of Nuclear Reactor Theory" by S. Glasstone and M. C. Edlund. This book serves as a good introduction to scientists who have no background of nuclear physics. It is based on a set of declassified lectures given by the authors to the Reactor School at the Atomic Energy Establishment, Harwell.

The first five chapters deal with the structure of matter and elementary nuclear physics in a simple way. Subsequent chapters contain an account of slowing down and diffusion of neutrons in moderators. A full account has been given of the calculations used in evaluating the critical size of a gas-cooled, graphite-moderated, natural uranium reactor. The effects of air-gaps, reflectors, temperature and poisons on reactivity of the reactor have also been discussed. The latter chapters deal with the special topics of shielding, instrumentation for a reactor and the damage done to structural materials when subjected to high radiation fluxes. There is also a concise appendix on the subject of radiation hazards.

The reviewer feels that apart from graphite moderator, some information regarding other moderators, e.g., heavy water should also have been included. It would have been better to include more about neutron attenuation in the chapter on reactor shielding. The inclusion of more numerical problems would also have been useful.

The book contains a readable account of elementary reactor calculations and is quite

useful for pile-engineers and science students.  
V. P. DUGGAL.

**Relativity for the Layman.** By James A. Coleman. (The William Frederic Press, New York), 1954. Pp. 131. Price \$2.75.

As the title implies, this book is intended to be a simple presentation of relativity theory for those who have not had any special training in physics or mathematics. This is done by means of an essentially experimental approach to the subject. More than two-thirds of the book deals with the difficulties encountered in pre-relativity physics and how they were solved by special relativity. This is followed by chapters on the general theory, relativistic cosmology and the basic ideas of the unified field theory.

The author has eminently succeeded in his attempt to present the subject to a layman. The treatment is mostly descriptive, with very few equations; but at the same time it is perfectly logical and is developed in a rigorous manner.

A minor criticism may be made that no account is given of the expanding universe in the chapter on cosmology. The book deserves to be read not only by the layman, but by every student of science. Even students taking a course in relativity could profitably read the book to get a better overall picture of the subject.

**Static and Dynamic Electron Optics.** By P. A. Sturrock. (Cambridge University Press), 1955. Pp. x + 240. Price 30 sh.

This book of about 200 pages is one of the Cambridge monographs on Mechanics and Applied Mathematics and gives a compact exposition of the theory of electron optics. The book is divided into two parts. Part I, on 'static electron optics' deals with the focusing of charged particles in static electromagnetic fields and is concerned with electron lens systems and the design of modern instruments like beta-ray spectrographs and mass-spectrographs. General procedures based on the older concepts like the Lagrange and Poincaré invariants and Hamilton's characteristic functions are set out for use in the investigation of electron optical problems of image formation and in the evaluation of the properties of machines designed for focusing charged particles.

Part II on 'dynamic electron optics' is concerned with the focusing of charged particles in time-dependent electromagnetic fields, i.e., with particle accelerators. One chapter of this part deals with uniform focusing in accelera-

tors while the other is concerned with 'the strong-focusing principle', the synchrotron having been considered in detail. The basis of mathematical approach to these problems is to regard time as 'just another co-ordinate' and to evaluate the stability of a machine by the application of the method of characteristic functions, developed in Part I, on 'static electron optics'.

This book is of particular interest because one of the author's aims has been to relate the theory of electron-optical instruments and particle accelerators to classical optics and dynamics. It will, no doubt, be useful to all those engaged in the design, maintenance and use of modern machines for work in nuclear physics, besides serving as a theoretical guide in electron-optics.

B. V. THOSAR.

**Advances in Carbohydrate Chemistry, Vol. VIII.** (Academic Press, Inc., Publishers, New York, N.Y.), 1953. Pp. xvii + 408. Price \$10.00.

The volume begins with an obituary of the late Sir James Irvine, one of the great pioneers of carbohydrate chemistry, his contributions being presented in brief outline.

J. M. Sugihara discusses the relative reactivities of the hydroxyl groups of sugars in the light of configurational relationships and neighbouring group effects and gives a detailed account of work on the selective etherification, selective esterification and hydrolysis and selective oxidation of sugars. The chapter on 2-deoxysugars deals with the occurrence, isolation and methods of detection of this group of compounds, some of which are of great biological importance. Methods of synthesis of 2-deoxysugars and the chemistry of transformation products obtained by oxidation, reduction, esterification and glycolysis of alcohols and amines are presented at length. The chapter on sulphonic esters of carbohydrates by R. S. Tipson gives an exhaustive account of this group of carbohydrate derivatives dealing with methods of preparation, their properties and reactions. This chapter will undoubtedly be the most useful in this volume to organic chemists in general. Two chapters deal with D-glucuronic acid, one on its synthesis and another on its mode of formation *in vivo*. The chapter on the trisaccharide, melezitose, presents the evidence which finally establishes it to be a glucoside of sucrose. Other chapters on the methyl ethers of D-mannose, on the composition of cane juice and molasses and on sea-weed polysaccharides will be of special interest to carbohydrate chemists.

The present volume comprising of contributions from leading workers in the field of carbohydrate chemistry and edited by the late C. S. Hudson and M. L. Wolfrom maintains the same high standard in scholarship and critical judgment characteristic of the earlier volumes in the series.

T. R. G.

**The Proteins—Chemistry, Biological Activity and Methods.** Vol. II, Part A. Edited by H. Neurath and K. Bailey. (Academic Press, New York), 1954. Pp. viii + 661; Part B, Pp. viii + 662-1418. Price \$14.00 and \$16.50.

Vol. II of this treatise consists of Chapters 12 to 26 and the author and subject indices for both the volumes. The first chapter in this volume is concerned with nucleoproteins and viruses, contributed by R. Markham and J. D. Smith. The chemistry and physics of nucleic acids are treated first, and followed by a discussion of nucleoproteins and the relationship between nucleic acids and proteins. The various plant and animal viruses are also discussed individually. T. P. Singer and E. B. Kearney contribute the next chapter on the Oxidising Enzymes. This is followed by a series of chapters on various individual proteins, such as respiratory proteins (F. Haurowitz and R. L. Hardin), toxic proteins (W. E. van Heyningen), milk proteins (T. L. McMeekin), egg proteins (R. C. Warner) and seed proteins (S. Brohult and E. Sandegren). The problem of protein metabolism in plants is discussed by F. C. Steward and J. F. Thompson. C. H. Li has contributed the chapter on protein hormones, while W. L. Hughes has discussed the proteins of the blood plasma and lymph.

Part B begins with an article by W. C. Boyd on the subject of antigens and antibodies and the problem of immunity. The next two chapters deal with structure proteins. J. C. Kendrew discusses those belonging to the fibroin, keratin and collagen groups. The discussion is essentially physical and is concerned with the ultimate molecular structure of these proteins in relation to their properties. The chapter on muscle contributed by K. Bailey, on the other hand, deals more with the chemical and biological aspects. However, here also X-ray and electron microscopic studies have given some valuable information.

N. M. Green and H. Neurath have contributed an extensive review on proteolytic enzymes. The last chapter is concerned with the problem of protein synthesis and the incorporation and turnover of amino acids *in vivo*.

In a rapidly growing subject as this, it is

impossible to make a book up to date. Already since the publication of these volumes important knowledge has been obtained regarding the structure of nucleic acids and nucleoproteins and of some proteins like insulin and collagen. The relationship between proteins and nucleic acids and their synthesis are being vigorously investigated. It is to be hoped that these expanding frontiers would be covered by the issue of supplementary volumes at suitable intervals. These however do not detract from the fact that the two volumes together form a comprehensive and authoritative account of the whole field of protein chemistry and the related physical methods of studying proteins.

G. N. RAMACHANDRAN.

(i) **Alepisauroid Fishes.** By N. B. Marshall. (*Discovery Reports*, Vol. XXVII), 1955. Pp. 303-36. Price 12 sh. 6 d. (ii) **Euphausiacea of the Benguela Current.** By S. P. Boden. (*Discovery Reports*, Vol. XXVII.) (Cambridge University Press), 1955. Pp. 337-76. Price 12 sh. 6 d.

(i) Dr. Marshall deals with Alepisauroid fishes. These large, swift, voracious, bathypelagic fishes, are little known. The *Discovery* collection is sufficiently extensive as to facilitate a review of their relationships. Of the six families included in the suborder Alepisauroidae, six species belonging to three families are described. The different features of members of this suborder are compared with those of the other suborder myctophidæ which are bottom dwelling. The suggestion that the Alepisauroidae are not monophyletic is examined fully.

(ii) The number describes the adult and developmental stages of Euphausiids collected by R. R. S. William Scoresby during her eighth commission and first survey of the Benguela current off the coast of S.-W. Africa. Of the fourteen species recorded, species of *Nyctiphanes* and *Euphausia* resemble very closely those of the California current in all details and even distribution. Similarity in physical oceanographic conditions in the two upwelling areas as well as in phytoplankton populations and successions in the two currents are considered responsible for morphological similarities. But definite conclusions are possible only after the second survey.

The developmental phases of four of the species are described. The possibility of the oceanic species, with a tendency for suppression of the number of larval stages, reverting to greater larval variations when brought into

the coastal current is discussed. Valuable information regarding the different stages is also presented.

Both these parts render Vol. XXVII invaluable and worthy of a place in any marine biological library.

C. P. G.

*International Review of Cytology*. Vol. III. Edited by G. H. Bourne and J. F. Danielli. (Academic Press), 1954. Pp. v + 530. Price \$9.50.

The *International Review of Cytology* has been offering a wide variety of fare to students of cytology and the present volume is no exception. There are interesting reviews on "The Nutrition of Animal Cells" (Waymouth), "Caryometric Studies of Tissue Cultures" (Bucher), "The Properties of Urethan Considered in Relation to Its Action on Mitosis" (Cornman), "The Significance of Enzyme Studies on Isolated Nuclei" (Dounce), "The Use of Differential Centrifugation in the Study of Tissue Enzymes" (Duve and Berthet), "Azo Dyes in Enzyme Histochemistry" (Pearce), "Microscopic Studies in Living Mammals with Transparent Chamber Methods" (Williams), "The Mast Cell" (Asb   Hansen), "Elastic Tissue" (Dempsey and Lansing) and "The Composition of the Nerve Cell Studies with New Methods" (Brattgard and Hyden).

Over a decade back, Walter (1942), stated: "It is not enough for the geneticist to know the chromosomal mechanism at the beginning of his story and the Mendelian moral at the end of it. Between these two fields of investigation lies the no-man's land of somatogenesis which forms a major and least known part of the hereditary tale". The volume under review contains three articles on different aspects of the problem of differentiation. Gustafson presents some enzymatic aspects of embryonic differentiation. Mitochondria are considered to play a role in morphogenesis. Since paternal antigens were detected in the mesenchyme blastula of hybrid sea-urchin larvae (Harding, Harding and Perlmann, 1954) it has been suggested that the nucleus could be presumed to take an active part in development at least by that time (p. 312).

The composition, structure and functional significance of giant salivary and lampbrush chromosomes still remain controversial in spite of the fact that the first reports on these structures date back to 1881 (Balbiani) and 1892 (Ruckert). After a critical review, Alfert considers that the peculiar organization of the

lampbrush chromosomes may be "to supply the oocyte with numerous materials necessary for the growth of the embryo"..... "In polytene chromosomes, this activity is restricted to definite regions which differ in nuclei of various tissues according to specific cell requirements" (p. 163).

The review, "How Many Chromosomes in Mammalian Somatic Cells?", by Beatty is thought-provoking. He emphasizes the necessity for classification of tissue into germinal (-gonia and -cytes) and somatic. "Are we to continue indefinitely with the suspicion that smear and squash techniques damage somatic mitoses (though not those of germ cells) and give an untrue appearance of inconstancy; that sections also give untrue pictures of somatic chromosomes (but not those of germ cells) by loss of parts of mitoses and difficulty in observation?"

A rapprochement between the Western and Eastern schools of genetics is desirable and in that context the following observations of Beatty deserve serious attention. "Eastern genetics, which visualizes only a minor role for the chromosomes in heredity and development, is predisposed to accept somatic inconstancy. Western genetics, which believes in a more detailed control of development and heredity by chromosomal determinants, is inclined to suspect reports of somatic inconstancy. In fact, somatic inconstancy is quite reconcilable with Western genetics. Western genetics is already committed, with certain obvious reservations to belief in a Weismannian isolation between soma and germ cells, and the chromosomal constitution of the somatic cells need not necessarily affect the process of passing unit characters from one generation to the next" (p. 187).

The volume would constitute an important addition to any library.

M. K. SUBRAMANIAM.

*Some Extinct Elephants, Their Relatives and the Two Living Species*. By P. E. P. Deraniyagala. (Ceylon National Museums Publication), 1955. Pp. 101 (with 48 Plates and 13 Text-Figs.). Price Rs. 6.

This publication is a mine of information to all concerned with the study of one of the most interesting orders, the Proboscidea. Both the extinct and the living species are dealt with.

A fair amount of space is devoted to systematics and pal  ontology, and these portions of the work must prove of greater interest to

those who have access to good museum and library facilities. Of particular interest to the field naturalist and others are the descriptions and accounts of the living species in Ceylon itself, with which the author is obviously extremely well conversant. The life-history, habits, capturing and training of the elephant in Ceylon are vividly described and profusely illustrated—though many of the photographs could have been of a higher standard.

While admiring the author's vast fund of knowledge, his untiring energy and his versatility (the sketches and many of the photographs are his own), one cannot help feeling that his enthusiasm for his subject may have lured him into enumerating too many sub-species. For example, only three living sub-species of *Elephas maximus* are listed by T. T. S. Morrison Scott of the British Museum of Natural History in his Check List, whereas the writer of this publication recognises eight or possibly nine.

The present volume is a little brief as the author himself confesses, but it has served to stimulate interest in a field worthy of exhaustive and intensive research. E. P. G.

#### Books Received

*Humidity*. By H. L. Penman. (The Institute of Physics, London, S.W. 1), 1955. Pp. 71. Price 5 sh.

*Principles and Practice of Field Experimentation*. By John Wishart and H. G. Sanders. (Commonwealth Agricultural Bureaux Farnham, England), 1955. Pp. 133. Price 21 sh.

*Physics of Fibres*. By H. J. Woods. (The Institute of Physics, 47, Belgrave Square, London), 1955. Pp. 100. Price 30 sh.

*Synthetic Drugs*. By H. Ronald Fleck. (Clea-ver Hume Press, Ltd.), 1955. Pp. viii + 380. Price 70 sh.

*Organic Insecticides—Their Chemistry and Mode of Action*. By Robert L. Metcalf. (Interscience Pub.), 1955. Pp. ix + 392. Price \$ 8.50.

*International Review of Cytology*, Vol. IV. Edited by G. H. Bourne and J. F. Danielli. (Academic Press, Inc.), 1955. Pp. vii + 419. Price \$ 9.00.

*Antibiotics in Nutrition—Antibiotics Monographs*, Vol. IV. By Thomas H. Jukes. (Interscience Publishers, Inc.), 1955. Pp. 128. Price \$ 4.00.

*Chemical Engineering*, Vol. II. By J. M. Coulson and J. F. Richardson. (Pergamon Press, Ltd.), 1955. Pp. xvi + 387-975. Price £ 3.

*Hydrogen Ions—Their Determination and Importance in Pure and Industrial Chemistry*, Vol. I. Fourth Edition. By Hubert T. S. Britton. (Chapman & Hall), 1955. Pp. xix + 476. Price 70 sh.

### USE OF RADIOACTIVE TRACERS IN THE STUDY OF PLANT PHYSIOLOGY

INTERESTING data relating to the movement of substances in the plant tissues have been obtained by the use of radioactive tracers and were reported at the Geneva Conference on the peaceful uses of atomic energy. Some of the more important findings from isotope tagging are as follows:

Movement of fluids in the plant is not slow, as had been thought. Products of photosynthesis usually reach the growing points in 20-40 minutes. They travel from leaves to roots at 70-100 cm. an hour and towards fruits and growing shoots at 40-60 cm. Phosphorus reaches leaves 15 or 20 minutes after the root has made contact with a fertiliser granule. When a root reaches a granule its capacity to absorb nutrients increases twenty- or thirty-fold and it can supply most of the whole plant's requirements.

Two to three days after a seed has germinated, the seedling's roots can reach phosphorus 3-4 cm. below it. If the fertiliser is placed

5-6 cm. to the side and the same distance below the seed, contact is delayed for 3 or 4 weeks. Vitamins and amino acids synthesised by soil micro-organisms are easily taken up by roots. Roots are also known to synthesise 14 amino acids. Carbon dioxide is absorbed by roots from the soil and translocated to the leaves, where its role in photosynthesis is as important as that of carbon dioxide from the air.

The "material handling" system in the plant is marvellous but not infallibly efficient. Low starch content of potatoes grown in North Russia was diagnosed as being due to interference in the flow of nutrients to the tubers by the products of carbon dioxide assimilation. Experiments to reduce this interference are an early essay in techniques for manipulating the composition and direction of plant fluids. The Russian scientists also claim success in promoting the growth of sugar-beet, cotton and cabbages by spraying nutrients on foliage—and also by fumigation.

## SCIENCE NOTES AND NEWS

### Study of Cell Growth

A plan of action has been submitted to the UNESCO by prominent biologists to encourage internationally or regionally, research on normal and abnormal cell growth.

In particular, it was suggested that an international committee be formed to collect information on research now in progress in this field, and to give assistance which would include not only the organization of meetings and the granting of scholarships, but also the establishment of breeding centres for laboratory animals. The establishment of a special laboratory for the study of plants and animals living under perfect conditions of humidity, temperature, radiation, etc., was also recommended. The biologists asked UNESCO to pay special attention to research on the frequency of different types of diseases according to regions.

### International Atomic Energy Course for Management

The first international course on atomic energy to be conducted especially for business executives will be held February 27 through March 3 and repeated April 30 through May 5 at the Westchester Country Club, just outside of New York City. Consisting of lectures, demonstrations and discussions, the course will be taught by an outstanding faculty of scientists, engineers and businessmen. Enough time is set aside for informal sessions and small group discussions to assure each man attending an opportunity to explore subjects of particular interest to him. Also scheduled as part of the course is an extended tour of Brookhaven National Laboratory, one of the finest atomic research laboratories in the United States. Those wishing detailed information about these courses can obtain it by writing to the National Industrial Conference Board, 460, Park Avenue, New York City, or cabling NICBOARD, New York.

### Endemic Fluorosis

Fluorosis of the skeleton results in increased density of bones, with formation of osteophytes, and calcification of ligaments, tendons, and interosseous fasciae. All bones may be affected, but the changes are usually greatest in the vertebral column; when severe, they

cause pain in the back, stiffness and limitation of spinal movements. Radiographs show diffuse osteosclerosis, with formation of new bone from periosteum and calcification of ligaments.

In Hyderabad-Deccan this field has so far remained unexplored from a clinical point of view, although fluorosis is prevalent in many parts. A paper by A. H. Siddiqui in the *British Medical Journal* (p. 1,408, Dec. 10, 1955), describes in detail the various clinical features of endemic fluorosis met with in Nalgonda District, with special reference to attendant neurological manifestations, both in human subjects and in animals.

### Rauwolfias for Research

As announced earlier in this Journal (1955, 24, 323), M/s. Rajaranga & Co., Ltd., 5, Thambu Chetty Street, Madras-1, have given away their entire stock of *R. beddomei* and *R. micrantha* roots for investigational purposes.

They have however a surplus of 900 lb. of *R. serpentina* roots of West Coast origin and 400 lb. of the same of Nepalese origin for gratuitous distribution for clinical investigation, experimentation and scientific research in recognised hospitals, University or Research Laboratories, on request, on a F.O.R. Madras basis.

### Symposium on Antibiotics

It has been arranged to hold a Symposium on Antibiotics—their production, utilization and mode of action, at Pimpri, sometime towards the end of March 1956, so that workers in this field could meet for a general discussion and exchange of views. The scope of the symposium will be as follows: Production and Technology, Chemistry and Biosynthesis, Mechanism of Action and Applications. Those who wish to participate in the Symposium are requested to contact Dr. A. Sreenivasan, Convener of the Steering Committee for the Symposium, and Professor of Biochemistry, Department of Chemical Technology, University of Bombay, Matunga Road, Bombay-19. Copies of papers (along with abstracts of about 300 words) should be sent to him by January 31, 1956. It is proposed to publish in the form of a brochure the various communications to the Symposium along with the discussions at the meeting.



**Raptakos Medical Fellowships Award**

The Raptakos Medical Research Board Fellowships for the year 1956 have been awarded to the following candidates: P. P. Nair (Institute of Science, Bombay), E. R. Divakaran (Presidency College, Calcutta-12), S. H. Kamath (Institute of Science, Bombay), Jitendra Sahay (Prince of Wales Medical College, Patna), and P. N. Chatterjee (Christian Medical College Hospital, Vellore, South India).

**Bombay Natural History Society**

The Bombay Natural History Society is now in a position to offer some financial assistance to carry out field work in natural history, including collection of specimens or data or the investigation of specific problems.

Applications should be addressed to: The Honorary Secretary, Bombay Natural History Society, 114, Apollo Street, Bombay, stating (1) the nature of the problem; (2) the experience and qualifications of the candidates, and (3) the amount required, with itemized details of how it is proposed to be spent. Applications should be received by the undersigned before 31st January 1956.

**The Indian Botanical Society**

At the Thirty-Fifth Annual General Meeting of the Indian Botanical Society held recently, the following were elected as office-bearers of the Society for 1956:

*President:* Dr. A. C. Joshi, Chandigarh; *Vice-Presidents:* Professors P. Maheshwari, Delhi; and Rev. Fr. H. Santapau, Bombay; *Secretary:* Prof. J. Venkateswarlu, Waltair; *Chief Editor, Business Manager and Treasurer:* Prof. T. S. Sadasivan, Madras.

**National Institute of Sciences of India**

The following were elected as office-bearers for 1956 at the Annual General Meeting held on 1st January:

*President:* Dr. A. Ukil (Calcutta); *Vice-Presidents:* Dr. K. R. Ramanathan (Ahmedabad) and Prof. S. P. Agharkar (Poona); *Treasurer:* Prof. D. S. Kothari (Delhi);

*Foreign Secretary:* Prof. P. C. Mahalanobis (Calcutta); *Secretaries:* Prof. R. C. Majumdar (Delhi), Dr. B. P. Pal (Delhi); *Editor Publications:* Prof. J. M. Sen (Calcutta).

The following new Fellows were also elected:

*Ordinary Fellows:* Dr. J. N. Basu, Calcutta; Dr. J. N. Bhar, Calcutta; Dr. P. Bhattacharya, Izatnagar; Sri. V. Cadambe, New Delhi; Dr. R. N. Chakravarti, Calcutta; Prof. K. V. Giri, Bangalore; Sri. B. L. Gulatee, Dehra Dun; Dr. B. M. Johri, Delhi; Sri. S. L. Malurkar, Bombay; Dr. R. K. Pal, Calcutta; Dr. S. P. Ray-chaudhuri, Calcutta; Lt.-Col. Jaswant Singh, Delhi; Dr. Satya Swaroop, Switzerland; Dr. M. J. Thirumalachar, Pimpri. *Honorary Fellows:* Prof. Peter Kapitza, Moscow; Prof. Hans Adolf Krebs, Oxford; Prof. A. N. Nesmeyanov, Moscow; Prof. Hans Selye, Canada.

**Indian Phytopathological Society**

At the Annual General Meeting of the Indian Phytopathological Society held recently at Agra, the following office-bearers were elected to the Council for 1956:

*President:* Dr. M. J. Thirumalachar; *Vice-President:* Dr. B. L. Chona; *Secretary-Treasurer:* Dr. R. Prasada (for 1956-58); *Councillors:* Dr. M. R. S. Iyengar, Dr. R. S. Mathur, Dr. S. Chowdhury, Dr. S. Vaheeduddin, Dr. M. K. Patel and Mr. K. M. Thomas.

**Award of Research Degree**

The University of Reading, England, has awarded the Ph.D. Degree in Botany to Mrs. S. D. Chitale, of Nagpur, for her thesis entitled, "Contributions to the Knowledge of the Deccan Intertrappean Flora of India".

The University of Madras has awarded the Ph.D. Degree in Zoology to Shri K. N. Parameswaran for his thesis entitled, "Studies on *Enhydrys dussumieri* (Smith)".

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri K. A. Khasgiwale for his thesis entitled "Potentiometric Studies of Metal Amines, Double Salts and Metallic Soaps".

# Current Science

Vol. XXV]

FEBRUARY 1956

[No. 2

	PAGE		PAGE
<i>India's Resources in Atomic Minerals</i> ..	37	<i>Some Problems of Gondwanaland—</i>	
<i>The Antiproton</i> .. .. .	39	L. RAMA RAO .. .. .	44
<i>Bathythermograms—An Oceanographic</i>		<i>U.S. Satellite Program</i> .. .. .	45
<i>Tool—E. C. LA FOND</i> .. .. .	40	<i>Obituary—Dr. S. L. Hora—B. R. SESA-</i>	
<i>Peaceful Uses of Atomic Energy</i> ..	41	CHAR .. .. .	46
<i>The Primary Cosmic Radiation</i> ..	42	<i>Letters to the Editor</i> .. .. .	47
<i>Control of Cancer</i> .. .. .	43	<i>Reviews</i> .. .. .	66
		<i>Science Notes and News</i> .. .. .	71

## INDIA'S RESOURCES IN ATOMIC MINERALS\*

DEVELOPMENTS arising out of atomic research are likely to transform the world in the next twenty years by endowing it with a new source of power so versatile and responsive to human needs that it will put into shade the present three conventional sources of power, coal, petroleum and electricity. At present uranium holds the field as the primary fission metal in nuclear power production and thorium is a close second. There are, however, indications based on experimental data that soon there will be a neck-to-neck race, and the odds are that thorium will emerge as a fission fuel of greater potential than uranium in the near future. This prediction was made in several documents presented at the memorable Geneva Conference on the Peaceful Uses of Atomic Energy. The conversion of

thorium into U 233 in a breeder reactor is no longer a mere speculation. Thus the indications are that thorium will constitute, in the near future, a power resource of incalculable value in India, and this fact is being given prime importance in the plans that are being formulated by Prof. Homi Bhabha for employment of nuclear energy for peaceful uses.

The basic raw materials required for nuclear energy production are minerals and ores carrying: uranium, thorium, beryllium, lithium, zirconium and graphite. There are besides these a few subordinate natural mineral substances required as integral and shielding parts of nuclear power reactors. The procurement of these secondary minerals presents no difficulty, because India is in a comfortable position in having indigenous supplies and also because their import from open world markets is easy.

### URANIUM

Uranium in India is principally a product of igneous and metamorphic rocks, its genesis

\* From the Sir Thomas Holland Memorial Lecture entitled *India's Mineral Potentiality for Atomic Energy*, by Dr. D. N. Wadia, Geological Adviser, Ministry of Natural Resources and Scientific Research, Govt. of India.

being due to epithermal, mesothermal or hydrothermal agencies in granitic magmas, or to epigenetic action in large shear or thrust-zones.

Uranium ores in India belong to three categories: (i) Low-grade ores disseminated in Singhbhum and parts of Rajputana in Archæan and Dharwar rocks—The uranium content in these rocks varies from 0.03 to 0.1% with a few thin stringers and nests of higher concentrations. The poorer grade rock is available in large tonnage, a ton of rock yielding from  $\frac{1}{2}$  to  $2\frac{1}{4}$  lb. of uranium. The ore mineral present in this type is probably a primary uranium compound, capable of simple chemical leaching by the acid or carbonate methods. (ii) Complex uranium minerals occurring in pegmatites and other vein deposits—niobates, tantalates and titanates of uranium—form the second category. These have higher uranium content but their occurrence is highly sporadic. These ores are again difficult to process chemically as well as metallurgically. The more important pegmatites carrying uraniferous deposits are found in the Mica Belt area of North Bihar, mica mines area of Nellore in Madras and Central Rajputana. (iii) The monazite sands of Travancore and Madras coasts—The voluminous ilmenite (black sand) accumulations of these coasts, containing from 0.5 to 2% of monazite, constitute an easily accessible source of uranium, the exploitation of which will liberate large volumes of thorium and other rare-earth compounds. Average monazite yields from 0.2 to 0.46% of  $U_3O_8$  and from 8 to 10% of  $ThO_2$ . There are varieties of monazite much higher both in thorium and uranium values, e.g., the newly discovered variant (?) of monazite, the rare 'cheralite', which carries 4 to 6%  $U_3O_8$ , besides 19 to 33%  $ThO_2$ . Estimates of uranium available from the major monazite sand spreads located at various sites in the Malabar Coast and on the Coromandel Coast are of the order of several thousand tons.

#### THORIUM

The main source is monazite, a monoclinic phosphate of several rare earths and metals. The thorium content of Travancore monazite ranges from 8 to 10.5% as against 5 to 6% of the Brazilian and other foreign monazite. It occurs both as crystalline aggregates in granitic rocks of Hazaribagh, Mewar, Western Ghats and Madras, and as a constituent of beach-sands on the Malabar and Coromandel Coasts. It is the latter which constitutes the chief source of thorium metal, and the scale of mag-

nitude of its concentration on the Travancore littoral makes it an asset of world importance. The monazite has accumulated along with ilmenite, rutile and zircon along the seashores by a process of natural concentration out of the products of rock decay in the course of long geological ages. Detailed quantitative survey of the monazite occurring on Travancore-Cochin littoral has just been completed; it gives a total estimated reserve of a little over a million tons, for this sector of the west coast. A series of fresh occurrences of ilmenite containing variable percentages of this mineral, has been brought to light within the last three years at several widely scattered localities. These extend from Cape Comorin to as far north as the Narmada estuary on the west coast and beyond the Mahanadi from Tinneveli on the east coast. From data so far available, a provisional estimate of two million tons of monazite, carrying between 1,50,000 to 1,80,000 tons of  $ThO_2$ , may be accepted as a rather conservative figure.

The new mineral, cheralite (percentage composition:  $ThO_2$ —31.4,  $U_3O_8$ —4.43,  $P_2O_5$ —24.55 and  $SiO_2$ —3.12) and probably some other unnamed variants of monazite, with their thorium content as high as 19 to 33% found in recent years in small quantities in their rock matrices, though not likely to swell this figure materially, will form valuable local sources of supply of the highly potential fission metal.

#### OTHER MATERIALS

The rare metal beryllium, which is used as a moderator in atomic power plants, is available in India in the form of the mineral beryl, which occurs in fairly widely distributed pegmatites in various parts. Since 1949, fairly extensive workable deposits have been discovered in parts of Rajaputana and North Bihar, and the production of dressed beryl has risen to over a thousand tons per year. The stock-piling of this mineral in India is a feasible proposition and is being pursued.

Lithium, which is a likely source of helium in future thermo-nuclear fusion developments, occurs as a constituent of the minerals lepidolite and spodumene, occurrence of which in appreciable amounts are recorded from several localities. The Department of Atomic Energy can easily draw its requirements from known deposits.

India possesses large resources of zirconium in the mineral zircon. Zircon forms about 6% of the raw ilmenite sands of Travancore, but contains about 5% of hafnium, which has to be eliminated in the refining of zirconium for

atomic use. Another source is the mineral baddeleyite, also known in Travancore sand.

Graphite of a high degree of purity, especially free from boron, is required in the atomic reactor but is rarely found in the natural state. With four petroleum refineries in the country treating over  $3\frac{1}{2}$  million tons of crude oil yearly, there should be enough petroleum coke available for manufacture of artificial graphite.

#### PROSPECT FOR THE FUTURE

The vast extent of India covered under ancient crystalline rock formations, both in the Deccan Peninsular shield and the extra-Peninsular region of the north, particularly the Himalayan terrain, yet remains to be examined for its uranium potential as well as resources in ancillary atomic minerals. The million square mile Archæan and pre-Cambrian rock expanse, with its cover of basic lava flows in the north-west (many of which are known to have measurable content of uranium of the order of  $10^{-6}$  gram per gram of rock), is covered only in comparatively insignificant proportions by systematic geological prospecting and survey for uranium. So far the Himalayan region has

hardly been touched by these surveys. The Himalayas are regarded as generally barren in sizable mineral or metal veins or lodes. Its very recent orogeny and the observed poverty of this region of middle and late Tertiary uplift in metallogenic provinces has influenced this attitude amongst Indian geologists. But large areas of the inner Himalayas are yet geologically *terra incognita*, and need to be investigated by aerial geophysical surveys, especially in the central and axial parts of the range which are marked by a series of granitic and gneissic intrusions of immense sizes.

A planned programme of investigating these areas by ground and aerial surveys has been formulated, and the strength of the geological and physical personnel engaged in the Raw Materials Division of the Atomic Energy Department is being gradually increased.

It would be hazardous to predict any large accessions of uranium and thorium from these hitherto unknown regions; at the same time the prospect of discovering many commercially workable uranium deposits in new fields cannot be ruled out.

---

### THE ANTIPROTON

SINCE the discovery of the positron by Anderson, confirming Dirac's prediction on the basis of his theory of the electron, it has been generally assumed that the proton would also have its charge conjugate, the antiproton, a stable particle identical with the proton in mass and spin and having charge and magnetic moment equal but opposite to those of the proton. It would be expected to be generated in pairs with ordinary nucleons and to have the ability to be annihilated in interaction with them.

Workers at Berkeley have now announced the identification of antiprotons (by mass determination from momentum and velocity measurements) among particles generated by bombardment of a copper target by 6.2 BeV protons from the Berkeley bevatron. A minimum energy of 5.6 BeV is required for antiproton production in nucleon-nucleon collisions. They measured the momentum ( $p$ ) by an arrangement of magnetic lenses and fields which select negative singly charged particles with  $p = 1.19$  BeV/c; and velocity by a time of flight determination between two scintillation counters

40' apart. About 250 particles, with average mass of  $1840 \pm 90$  electron masses, were thus found. These were separated from the large number of accompanying  $\pi$ -mesons ( $> 44,000$  per antiproton) of the same momentum (and hence greater velocity) by making use of the velocity sensitivity of Cerenkov counters. Existing observations on stability and interactions of the particles are consistent with their identification as antiprotons.

The existence of the antiproton entails with virtual certainty the existence of the antineutron. Its experimental demonstration is a most interesting problem. Probably the neutron beam of the Berkeley bevatron contains an appreciable number of them, but their disentanglement from the ordinary neutrons appears a formidable task. It is likely that the best approach will be either: (1) to transform an antiproton into an antineutron by a collision with a proton; or (2) to convert an antineutron into an antiproton by collision with an ordinary neutron and detect either the antineutron or the antiproton produced by this process—(*Nature*, 1956, 177, 11.)

## BATHYTHERMOGRAMS—AN OCEANOGRAPHIC TOOL

E. C. LA FOND

*Andhra University, Waltair*

**B**ATHYTHERMOGRAMS—the Temperature *versus* Depth graphs made automatically by the bathythermograph as it is lowered into the sea, provide a wealth of information about the secrets of the sub-surface layers. These T-D data are easily acquired in a matter of a few minutes, and produce results with a remarkable degree of accuracy. When the various T-D data are studied and compared with other oceanographic factors they reveal many of the processes taking place in the sea.

The bathythermogram is important to every branch of oceanography. The marine biologist is aided in his efforts to determine the environment in which plants and animals flourish. The marine chemist requires the temperature structure in order to determine chemical reactions and the saturation point of the salts and gases. The physical oceanographer is especially concerned with the T-D character of the water, for the physical properties of the water itself are dependent upon its temperature. For example, water density, surface tension, viscosity, sound velocity, etc., are a direct function of temperature. For these many reasons, the study of the temperature of the sea has become an integral part of the oceanographic research programme at the Andhra University.

The vertical temperature structure of the sea off the Indian coasts may be described as a three-layer system, somewhat analogous to layers in the atmosphere. The upper or surface layer is called the "thermosphere" and consists of a changing zone of relatively warm near surface water. It is separated from the lower psychrosphere by the thermocline, a layer in which the temperature changes most rapidly with depth. The psychrosphere remains a comparatively stable colder region (see Fig. 1).

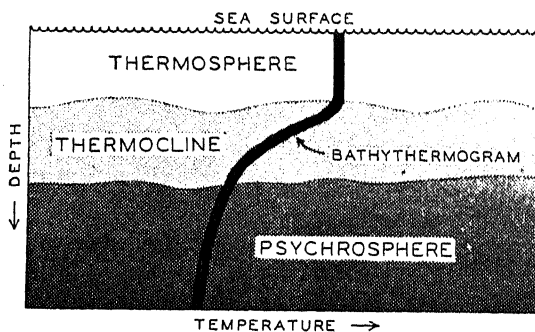


FIG. 1. Common type of bathythermogram and the related layers of the sea.

In this simplified version of the temperature structure, changes are continually taking place through external and internal forces such as tide, current, wind, etc. Also, heat exchange to and from the atmosphere occurs at the sea surface, which in turn, modifies the temperature structure in the thermospheric layer. Some of these environmental factors have a characteristic effect on the shape of the bathythermogram. These are sometimes discernible and reflect the history of the physical processes that have taken place in the water.<sup>1</sup> Several different types of bathythermograms are presented in Fig. 2 and their probable formation is discussed.

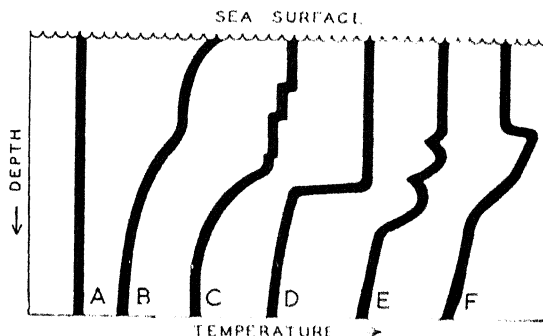


FIG. 2. Various types of bathythermogram observed in the Indian Ocean.

If the bathythermogram shows a continual vertical trace, i.e., isothermal water, from the surface to a depth of a few hundred feet, as shown in Fig. 2 A, it indicates that the water has been vigorously mixed by a strong wind, or that vertical advection by cooling at the surface has taken place. In the winter both processes frequently occur. A tropical hurricane in the Arabian Sea or Bay of Bengal will produce such isothermal bathythermograms.

In Fig. 2 B, the usual three-layer system is present. The thermocline has a gradual slope which is caused by diffusion and gradual mixing at that level. The increased temperature at the surface represents conduction of heat to the water from the atmosphere under low wind conditions. This type of T-D curve may be commonly found in the summer whenever the wind is light and the air is relatively warm and moist.

The step-like structure in the thermosphere depicted in Fig. 2 C is usually the result of successive surface heatings and wind mixings. Spring is the favourable season for such sur-

face water heating, through increased solar radiation and conduction and, coupled with irregular winds, produces this type of T-D structure.

The sharp thermocline boundary between thermosphere and psychrosphere, as shown in Fig. 2 D, occurs when one adjacent water-mass of different temperature flows over another at a different rate of speed or in a different direction. The diffusion of water and heat at the boundary of two such water-masses under these conditions is small. A similar T-D structure may also occur when a warm water type flows over a sub-surface depression or when a large river enters a colder sea. In each case the lighter water flows over the more dense layer without appreciably mixing at the thermocline.

Irregular wiggles in the bathythermogram, as illustrated in Fig. 2 E, are indicative of turbulence at current boundaries. These occur in the stronger current systems. For example, off promontories like the Godavari Delta, the along-shore current increases in speed and at the same time intermingles with coastal waters. This type of irregular and variable temperature structure is the result.

In Fig. 2 F is shown an increase in temperature below the surface, usually the result of cooling at the surface. In this case, the surface layer must contain low salinity water in order that the vertical column may remain in stable equilibrium. Along the east coast, immense quantities of fresh-water mix with Bay of Bengal water, producing a dilute thermospheric layer. In the fall, the surface cools by evaporation and conduction of heat to the atmosphere, causing vertical advection in the low salinity layer. Due to the higher salinity in

the thermocline the stability of the water is maintained, even with higher subsurface temperatures. Actually, the T-D structure of both Figs. 2 C and 2 F could indicate horizontal advection of a different shallow water-mass into the sampling area. However, the cooling and mixing process is the more common.

Various other shapes or combinations of shapes exist along the Indian coasts. Most can easily be explained. However, the cause of one feature shown in the deepest part of Fig. 2 C, namely, an isothermal layer near the bottom, is not apparent. Such a water structure exists on the edge of the continental shelf off Visakhapatnam in the spring. It might be caused by, (1) turbulence as the water flows across the bottom, or (2) by selective infiltration of water of a single temperature. This latter may be connected with upwelling along the continental slope at this time of year.<sup>2</sup>

These deductions are from a single bathythermogram. With many bathythermograms much more information can be ascertained. For example, repeated lowering in one location will give a measure of the wide variability and time cycles (diurnal, tidal, seasonal, etc.) in the water temperatures.<sup>3</sup> A line or network of observations will give two or three dimensional information. Consequently, from the character of a single bathythermogram, or group of bathythermograms, it is possible to deduce the processes that have taken place in a vertical water column in the sea. The bathythermogram is indeed a useful oceanographic tool.

1. La Fond, E. C., *Memoirs in Oceanography*, Andhra University, 1, 94.
2. —, *Ibid.*, 117.
3. — and Poornachandra Rao, C., *Ibid.*, 109.

## PEACEFUL USES OF ATOMIC ENERGY

THE United Nations wishes to announce the forthcoming publication of the Proceedings of the International Conference on the Peaceful Uses of Atomic Energy, held in Geneva, during August 1955, in their entirety.

*Peaceful Uses of Atomic Energy* will be published in sixteen volumes, each approximating 500 pages; they will comprise all papers submitted at the Conference (about 1,050), the text of the oral presentations at Geneva, and the *verbatim* record of the discussions on the Geneva papers. The publication provides for the first time a complete reference work on all the peaceful uses of atomic energy and will remain the standard text and basic documentation on this subject for many years.

Volume III, entitled, "Power Reactors", is the first of the sixteen to be printed, and has been released recently. It describes reactors now operating and plans for future reactors that will produce usable power in the form of heat or electricity. The types of fuels and how they will be used are also considered in this volume, which carries nearly 400 illustrations.

A complete list of the sixteen volumes is given at the end of this release, with the prices of each volume. The price for Volume III is \$7.50. Copies can be ordered from United Nations Official sales agents in various countries, or from H.M. Stationery Office, P.O. Box 569, London, S.E. 1.

## THE PRIMARY COSMIC RADIATION\*

COSMIC radiation was discovered nearly 50 years ago. Its effects were first observed as a small residual ionization in gases, which could not be attributed to natural radioactivity of the earth and of its atmosphere. From this modest beginning, a branch of physical science has developed which has profoundly affected and in some cases even revolutionized other fields of physics and has exerted a great influence on the development of other sciences, in particular, astrophysics and archaeology. Increasingly important contributions of cosmic ray research to geophysics, oceanography, meteorology and cosmology, possibly even to the biological sciences, must be expected.

In order to understand why results obtained in the study of cosmic rays have reached so far afield and have affected so many different branches of knowledge, we must consider separately three different aspects of the phenomenon of cosmic radiation: the incident particles themselves, the dissipation of their enormous energy inside the atmosphere, and the radioactivity which cosmic radiation produces on the surface of the earth.

The outer atmosphere of the earth is continuously being bombarded from all sides by various forms of radiation and matter: photons of greatly varying wavelengths, a stream of atomic nuclei of widely varying mass and energy, as well as aggregates of matter ranging in size from very fine particles of dust to that of large boulders. Our entire knowledge about the properties of the solar system and of the universe which surrounds us and of which we form an insignificant part, even our awareness of the very existence of this universe, is based on a study of some part of this radiation and matter which bombards us. The study of the electromagnetic radiation in the visible part of the spectrum has by far the longest scientific history and is responsible for most of our present knowledge of the universe around us, while the study of the incident particle radiation is comparatively new. Yet it has already taught us that the interstellar medium not only consists of turbulent gases and dust, but that it also consists of atomic nuclei moving with relativistic and near relativistic velocities and that it contains magnetic fields. One finds that the energy density due to cosmic radiation, to magnetic fields and to

the kinetic energy of interstellar matter are of the same order of magnitude. It is clear that these facts alone are of the greatest importance for theories dealing with the development of stars and galaxies and is fundamental to all problems of cosmology. The details of the chemical composition of cosmic radiation, its density and velocity distribution, its variations in time and space, will have to be understood in terms of the present physical conditions of our universe and thereby serve as tools to explore these conditions. In this way cosmic ray physics has become a part of astrophysics and cosmology.

On impact with the atmosphere the particles of the cosmic radiation destroy nitrogen and oxygen nuclei which they encounter and decompose them into their constituent parts (protons, neutrons and aggregates of these particles); in addition, a large part of their enormous kinetic energy is transformed into a variety of highly unstable particles which subsequently decay through complicated chain events back into stable forms of matter. It is clear that the appearance of these particles (which are called mesons and hyperons) in high energy collisions is closely linked with the properties of the colliding protons and neutrons and is useful in explaining the force responsible for their aggregation into the nuclei of elements which we observe on the earth. The role which these unstable particles play in the structure of matter is not yet clear; almost all of them were first discovered in cosmic radiation, and these discoveries provided the impetus for building the large accelerators which now are among the most valuable tools for the investigation of nuclear forces. Thus, cosmic ray physics is an important part of nuclear physics.

The significance of cosmic ray work for archaeology, geophysics, oceanography and meteorology rests on the fact that during the complicated processes of interaction between cosmic radiation and its progeny with the atmosphere and the surface of the earth, a number of radioactive nuclei are produced with greatly varying half lives. These half lives, though often quite long, are much shorter than those of naturally occurring radioactive substances which have survived in measurable quantities on the earth and in meteorites since the creation of elements some 5 billion years ago. There are two ways in which these radioactive nuclei are produced by cosmic rays. They may be produced directly by the partial

\* Abstract of Presidential Address of Prof. B. Peters to the Physics Section at the 43rd Session of the Indian Science Congress, 1956.

fragmentation of nuclei in the air, or they may be produced by the capture of cosmic ray-produced neutrons after these neutrons have been slowed down.

The first group contains the recently discovered cosmic ray-produced  $\text{Be}^7$  (half life 53 days), which may be useful for studying the circulation of air-masses between the stratosphere and lower atmospheric layers, and may also give information on the vertical circulation of ocean water. Another collision product is tritium (half life 12.5 years), whose concentration in lake and well water reservoirs has been used to obtain information on the rate at which these reservoirs are fed by contemporary water from recent precipitations.

Among the radioactive isotopes produced by slow neutron capture, the most important one is  $\text{C}^{14}$  (half life 5,600 years) which has been used primarily to determine the time at which various organic materials have ceased to participate in the exchange of  $\text{CO}_2$  between the atmosphere and the biosphere. The time of death can, therefore, be measured from the  $\text{C}^{14}$  concentration in the remains of plants, animals of humans and this technique has proved of great value for archaeological research.

Whether cosmic radiation is of importance to the biological sciences, is not clear. Since all high energy radiation is capable of producing mutations, continuous cosmic ray bombardment, particularly at high elevation, must have been responsible for some genetic changes. It may, however, not be of sufficient importance, compared with other agencies of mutation, to have influenced markedly the history of evolution.

The experimental results on the primary cosmic ray nuclei have shown how their chemical composition, state of ionization, energy spectrum, spatial isotropy and intensity variations in time can be used to derive information on (1) the composition and temperature distribution of the region of the galaxy in which the particles originate; (2) the nature of their

trajectories in interstellar space; and (3) the distribution of gas clouds and magnetic fields in the galaxy and in the solar system.

Various theories have been proposed as to how particles could be accelerated in the galaxy to very high energies. Magnetic variable stars, and stars whose magnetic axis does not coincide with their axis of rotation have been investigated in some detail as possible accelerators. The conversion of the kinetic energy of interstellar gas clouds into cosmic ray energy has also been considered. There are serious objections to these proposals. Nevertheless it is possible that they play a role in the production of cosmic rays.

However, one celestial object has been discovered which does accelerate particles to cosmic ray energies, although we do not understand how it accomplishes the acceleration. The object is the so-called Crab Nebula, a rapidly expanding luminous gas cloud resulting from the explosion of a supernova, which according to Chinese sources occurred about 900 years ago. The total energy which is converted in the Crab Nebula into kinetic energy of particles is of a magnitude which is perhaps sufficient to account for the total observed cosmic ray intensity if one assumes that (as indicated by observations on other galaxies) our galaxy produces on the average one supernova every 200 or 300 years.

It is not clear as yet, whether the observations on the Crab Nebula are consistent with its emitting cosmic ray particles of energies as high as  $10^{10}$  e.v. or whether we have to look for other mechanisms in this ultra high energy region. The detailed mechanism of acceleration and the origin of the enormously high magnetic field energy appearing in this supernova explosion are also as yet quite unknown. Nevertheless the existing evidence gives strong support to the hypothesis that supernovae and perhaps novae are sources of cosmic radiation.

## CONTROL OF CANCER

THE discovery and isolation in pure form of a substance, named fertilizin, which produces a serum that inhibits the division and multiplication of specific cells was announced at the annual meeting at Atlanta, Georgia, of the American Association for the Advancement of Science.

The substance was isolated from the gelatinous coat of a sea urchin's egg by Dr. Albert

Tyler, Professor of Embryology at the California Institute of Technology. When injected into rabbits or chickens, it leads to the production in their blood of serum that acts specifically against the dividing mechanism of the fertilized egg.

Fertilizin is described as belonging to a group of substances, glycoproteins, made up of sugar and amino acids.



## SOME PROBLEMS OF GONDWANALAND

SINCE the idea of Gondwanaland was first put forward seventy years ago, considerable work has been done in different areas on the stratigraphical, palæontological and tectonic aspects as a result of which we have some idea of the main events in the history of this ancient continent. But the picture of the geological history of Gondwanaland is still far from being complete. We find that new discoveries from time to time have often revealed new possibilities of interpretation, necessitating constant revision of our older ideas. From an overall review of the present position, it is clear that there are still quite a number of problems connected with Gondwanaland requiring proper elucidation. The object of the present paper is to draw attention briefly to some of these problems.

When and how exactly did the Gondwanaland come into existence? When and how exactly did it disappear? Although we commonly talk of the first appearance of Gondwanaland in the Upper Carboniferous period, and connect its birth in some way with the earth movements of that period (Hercynian), the main question is still there to consider, *viz.*, how was this continent actually built up? What exactly was the position regarding these land masses (comprised within the Gondwanaland) and their mutual relationships in the pre-Upper Carboniferous times? To tackle this point, it is necessary to make a detailed comparative study, age by age, of the terrestrial and fresh-water deposits of the earlier periods, with their faunas and floras, found in the present representatives of Gondwanaland, and determine their mutual relationships.

Regarding the disappearance of Gondwanaland, the current view is that this disruption took place in stages, at different times in different places, during the period ranging from Lower Cretaceous to the Lower Eocene. The exact chronological sequence of these stages, and their connection, if any, with the beginnings of the Himalayan upheaval on the one hand, and the Deccan Trap eruptions on the other, have yet to be worked out. There is also the more fundamental question of how this disruption took place,—submergence and/or drift? It may be pointed out that these studies regarding the appearance and disappearance of Gondwanaland have also an important bearing on the problem of fixing the

lower and upper age limits of the Gondwana system in each of the present different parts of the old Gondwanaland.

There are also the questions regarding the land and sea connections during the Gondwanaland period. What exactly was the nature of the land connections, if any, between the southern Gondwanaland and the northern Laurasia? When and where did these connections exist? Were they continuously in existence in the same places, or were these connections of the 'make and break' (rhythmic) type shifting about in place and time? What exactly was the nature of the connections between the different parts of the Gondwanaland itself? Several views on these matters have no doubt been expressed from time to time, but there is still a lot of confusion and controversy. A proper solution of these palæogeographical problems must of course take into account the distribution and mutual interrelationships of contemporary faunas and floras. On the one hand, we have cases of admixture of the northern and southern land floras across the Tethys; and, on the other, there are the evidences of admixture of the Tethyan and Indo-Pacific marine faunas across Gondwanaland. All these have yet to be fully investigated and properly interpreted.

Then again, there are the problems connected with the glaciation in Gondwanaland. While the fact of glaciation has been established in several parts of Gondwanaland, the exact age and time-distribution of this glaciation in the different areas, the centres of dispersal of these ice sheets, the question whether there were local or uniformly spread glacial and inter-glacial periods, and, if so, their number and mutual correlation,—are still some of the points requiring full investigation. These studies will also have an important bearing on any theory accounting for this ice age.

In addition to the above, we have the whole field of 'Gondwana Floras' still requiring proper attention. The constituents of the Glossopteris flora in the different parts of Gondwanaland, and their relation to the other contemporary palæobotanical provinces have yet to be fully worked out. Our knowledge of the Upper Gondwana floras is also very limited. It may be said that the whole field of palæobotanical investigations of the flora of Gondwanaland still remains to be fully and systematically explored.

The above are some of the major problems (and at some stage, they all get interrelated)—connected with Gondwanaland, requiring further studies. While it is true that on many of these topics, ideas have been expressed and views put forward from time to time, on the basis of local researches, we have hardly dealt with these problems on a 'Gondwanaland basis', as we must do to evolve a consistent and comprehensive view of the geological history of this ancient continent, and fit it in properly within the wider picture of contemporary Earth History as a whole. These basic and fundamental problems cannot be solved by piecemeal

and unco-ordinated research in scattered areas; what is really necessary now is to initiate and carry out intensive and co-ordinated team work according to a well considered 'master plan' to be drawn up by a competent and authoritative agency.

In this connection it is gratifying to note that an International Gondwana Commission has already been set up, and a memorandum incorporating the views of Indian geologists on the subject has been submitted by Dr. D. N. Wadia for discussion at the forthcoming session of the International Geological Congress at Mexico in September 1956.

L. RAMA RAO.

### U.S. SATELLITE PROGRAM\*

TWO additional areas of activity in relation to the worldwide programmes for the International Geophysical Year 1957-58 are of special interest: rocket studies of the upper atmosphere, and the recently announced satellite studies, which represent a logical extension, technically and conceptually, of the rocket programme.

Rockets permit us to make direct measurements of quantities that are either only indirectly observable or are not observable at all, from the ground. They also provide a technique for measuring the altitude dependence of various geophysical parameters. Unfortunately, rockets have two serious disadvantages: (i) their total flight is extremely short and the time spent in a particular altitude range is even shorter; and (ii) their flight paths are restricted in terms of geographic coverage.

Thus, in spite of the very great value of rocket data, much of which is attainable only by rocket methods, there exists a need for a device that can provide synoptic data over the earth at high altitudes, over appreciable periods of time. As examples, one can cite the following: fluctuations in such solar effects as ultraviolet radiations and X-rays, cosmic ray intensities, current rings encircling the earth, and particle streams impinging on the high atmosphere. These and other phenomena are among the most important problems connected with the physics of the upper atmosphere and with solar-terrestrial relationships.

Clearly an earth satellite would permit observations of the kind indicated above, and the following types of experiments would seem

desirable: (i) determination of outer atmosphere densities by observation of the air-drag effect on the satellite's orbit; (ii) obtaining of more accurate measurements of the earth's equatorial radius and oblateness and of intercontinental distances and other geodetic data than are presently available; (iii) long-term observations of solar ultraviolet radiation; (iv) studies of intensities and fluctuations in intensity of the cosmic and other particle radiations impinging on the atmosphere; (v) determination of the density of hydrogen atoms and ions in interplanetary space; (vi) observations of the Störmer current ring; (vii) if possible, determination of the distribution of mass in the earth's crust along the orbital track.

How many and what experiments will be undertaken cannot be specified at this time. In part, these depend on the number, size, and pay-load capacity of the satellites. In part, they would depend on choices yet to be made by the United States National Executive Committee for the IGY, in collaboration with interested scientists, for in all probability, more experiments will be proposed than can be fitted into the IGY satellite program.

Work on technical details of the satellite is currently under way. Information now available indicate that the satellites will be small; they will contain scientific instruments; they will be trackable from ground by optical and radio techniques; they will probably be visible to the naked eye under optimum conditions at dawn and dusk, and certainly observable under good atmospheric conditions by means of binoculars and wide field optical equipment.

In size, the satellite may be described as about that of a basketball, although the shape

\* From an article by Joseph Kaplan and Hugh Odishaw in *Science*, 1955, 122, 1003.

has not yet been fixed. Each satellite will weigh more than 20 lb. but probably less than 50 lb. The satellite will travel about the earth in an elliptical orbit, with a perigee distance of at least 200 miles and an apogee distance of some 800 miles. It is expected that the

satellite will remain in its orbit for at least several weeks and perhaps for months. The velocity of the satellite will be approximately 18,000 miles per hour, giving a period of about an hour and a half, depending on the precise perigee and apogee values.

## OBITUARY

DR. S. L. HORA

THROUGH the sudden and unexpected death of Dr. Sunder Lal Hora, D.Sc., F.R.S.E., C.M.Z.S., F.N.I., on the 8th December 1955, at Calcutta, Indian Zoology has lost an inspiring investigator and Indian ichthyology one of her most brilliant exponents. He had a heart attack on 5th December while giving a lecture at the Asiatic Society and was removed to hospital where he passed away on the 8th December.

A son of the late Lala Gobind Sahai Hora, Dr. Hora was born at Hafizabad, Punjab, in May 1896. His early education was at Jullundur whence he went to the Government College, Lahore. Lahore was then one of the acknowledged centres of zoological teaching and research in the country, and Dr. Hora belongs to a band of brilliant and outstanding figures that have contributed so much to the shaping of teaching and research in zoology in India. After a distinguished record in college, Dr. Hora was appointed to the Zoological Survey as Assistant Superintendent in 1921. From then on, excepting for five years (1942-47) when he was the Director of Fisheries in Bengal, he served the Survey in various capacities and became its Director in 1947 which post he held till his death.

Dr. Hora's researches covered a wide field. His many memoirs in the publications of the Indian Museum, of the Asiatic Society and other journals in India and abroad, bear testimony to the high quality of his work and his penetrating insight into the problems of the systematics, ecology and evolution of Indian fishes. His knowledge of the fresh-water fishes of the whole subcontinent was extensive and complete, and under his guidance many workers have helped to elucidate problems of the taxonomy and relationships of Indian fishes. He was generous with material and advice, and students and colleagues could go to him with entire confidence of receiving all consideration and help.

He was a member of many learned societies in India and abroad, and was associated with the initiation and development of a large number of scientific organizations in

this country. He was a President of the Indian Science Congress, the National Institute of Sciences, the Zoological Society of India, the National Geographical Society of India and the Indian Ecological Society.

Among the many honours bestowed on Dr. Hora may be mentioned the title of Rai Bahadur in 1936, the Joy Gobind Law Memorial Medal of the Asiatic Society in 1944, the Jawaharlal Nehru Medal of the Indian Geographical Society (1951) and the Sir Dorab Tata Memorial Medal of the Zoological Society (1953). He was also chosen to represent India at a number of international scientific conferences. In 1946, he attended the Royal Empire Scientific Conference and the British Commonwealth Scientific Conference; in 1948, he took a leading part in the FAO Fisheries Conference at Baguio (Philippines); in 1949, at the invitation of the Secretary-General of the United Nations, he opened a discussion on "Pond Culture of Warm Water Fishes" at the U.N. Scientific Conference on the Conservation and Utilization of Resources at Lake Success (U.S.A.). He also represented the Indian Science Congress Association at the Jubilee Meeting of the Australian and New Zealand Association for Advancement of Science at Brisbane (Australia) in 1951 and the Annual Meeting of the British Association for Advancement of Science at Liverpool (U.K.) in 1953. In 1954, he attended as a delegate from India the Second Congress of the Pan Indian Ocean Science Association held at Perth (Australia). Recently, he was designated by the Government of India as a member of the UNESCO panel of experts on human ecology and arid zone research and was to have represented the Indian Science Congress Association at the Annual Meeting of the Pakistan Science Association at Dacca in January 1956.

In recent years he became interested in the ancient Hindu lore of fishes and fisheries, and his contributions in this field constitute an important chapter in the history of sciences in India.

B. R. SESHACHAR.

## LETTERS TO THE EDITOR

	PAGE		PAGE
New Vibrational Analysis of the Visible Emission Bands of $\text{Cl}_2^+$ —P. TIRUVENGANNA RAO AND P. B. V. HARANATH	47	A New Reagent for Gravimetric Estimation of Iron—R. P. SINGH	59
On the Determination of Dipole Moment and Relaxation Time at 3 cm.—CH. RADHAKRISHNA MURTY AND D. V. G. L. NARASIMHA RAO	49	Echinorhynchotænia lucknowensis N. Sp. (Hymenolepididæ: Cestoda) from Darter, Anhinga melanogaster Pennant.—K. P. SINGH	59
Dielectric Properties of Ethyl Acetate in the Ultra High Frequency Region—K. V. GOPALA KRISHNA	49	Occurrence of Two Wood-Boring Pholads at Madras—A. DANIEL AND V. V. SRINIVASAN	59
Steel Targets Attacked by Explosives with Lined Cavities—SAMPOORAN SINGH	50	Occurrence of a Mermethid Worm Parasite on Helopeltis theivora Waterhouse—DURGADAS MUKERJI AND SAMBHUNATH RAYCHOUDHURI	60
Elastic Constants of Thallium Alum—S. V. SUBRAHMANYAM	51	Photoperiodic Behaviour of "Thailand"—A Philippine Variety of Rice—B. SAMANTARAI AND G. MISRA	61
Water-Masses in the Bay of Bengal—C. POORNACHANDRA RAO	51	Life-History and Host Range of Prodecatomia pongamiæ Mani and Kurian (Hymenoptera—Family Eurytomidæ)—H. L. KULKARNY AND N. L. HALLEPPANAVAR	62
Nuclear Scattering of High Energy Electrons by Light Elements—(MISS) M. K. ADVANI AND K. M. GATHA	53	Further Studies on Scilla hohenackeri Fisch. & Mey.—Y. SUNDAR RAO	63
Occurrence of Lignitic Material in the Godavari Delta—T. V. S. R. KSHIRA SAGAR AND B. B. G. SARMA	54	Technique for Artificial Inoculation of Cotton Plants with Macrophomina phaseoli—L. MONIZ, M. J. THIRUMALACHAR AND M. K. PATEL	64
On the Estimation of Iron by Iodometry—D. PATNAIK, G. MAHAPATRA AND A. CHIRANJEEBI	55	Studies on Sorghum nitidum Pers.—N. KRISHNASWAMY, V. S. RAMAN AND P. CHANDRASEKHARAN	64
Benzoin Condensation of Salicyl Aldehyde—R. J. PHADKE	56		
Peroxy Titanium Oxalate—D. P. KHARKAR AND C. C. PATEL	56		
Antibiotic Principle of the Leaves of Withania somnifera—P. A. KURUP	57		
Dilutors for Buffalo Semen—P. N. SRIVASTAVA AND S. S. PRABHU	58		

### NEW VIBRATIONAL ANALYSIS OF THE VISIBLE EMISSION BANDS OF $\text{Cl}_2^+$

THE emission spectrum of chlorine as excited in a high frequency discharge is well known to consist of a large number of red degraded bands extending from  $\lambda$  6500 to  $\lambda$  3400. Preliminary analysis of the bands was first reported by Uchida and Ota,<sup>1</sup> who arranged them into three systems. Elliot and Cameron<sup>2</sup> in a re-investigation of the spectrum obtained more accurate data of the bands and arranged some of them into two systems. From the even multiplicity of the levels observed from the

rotational analysis of some of the bands, they concluded that the emitting molecule is  $\text{Cl}_2^+$  and attributed the two systems to the transition  $^2\Pi-^2\Pi$  although they did not rule out the possibility of a  $^4\Delta-^4\Delta$  transition.

Howell,<sup>3</sup> in a recent paper criticised the analysis of Elliot and Cameron from various aspects. Firstly, there is a large number of gaps in the analyses and also a large number of bands unclassified. Secondly, the intensity distribution in the systems is inconsistent with the values of  $\omega'$  and  $\omega''$  derived from the analyses. Lastly the energy of dissociation of the ground state  $^2\Pi$  of  $\text{Cl}_2^+$  is found to be

TABLE I  
Isotope effect

SYSTEM I				SYSTEM II				SYSTEM III			
$(\text{Cl}^{35}\text{Cl}^{35})^+$		$(\text{Cl}^{35}\text{Cl}^{37})^+$		$(\text{Cl}^{35}\text{Cl}^{35})^+$		$(\text{Cl}^{35}\text{Cl}^{37})^+$		$(\text{Cl}^{35}\text{Cl}^{35})^+$		$(\text{Cl}^{35}\text{Cl}^{37})^+$	
$\nu'$	$\nu''$	Cal.	Obs.	$\nu'$	$\nu''$	Cal.	Obs.	$\nu'$	$\nu''$	Cal.	Obs.
14,	0	53.2	53	17,	0	63.3	62	13,	0	49.5	49
14,	1	44.6	45	16,	0	60.6	61	12,	0	46.2	46
13,	1	41.3	41	17,	1	54.7	56	13,	1	40.9	38
11,	2	26.1	26	16,	1	52.0	53	12,	1	37.6	38
11,	3	17.9	17	15,	1	49.1	49	12,	2	29.3	29
11,	4	9.9	10	16,	2	43.6	44	11,	2	25.9	26
5,	5	20.4	18	15,	2	40.7	42	5,	5	20.1	20
6,	6	23.9	24	8,	6	14.5	15	5,	6	27.3	27
3,	6	36.2	36	7,	6	18.4	17	6,	7	30.1	32
7,	7	27.2	29	9,	8	24.7	27	3,	8	49.2	47

4.4 e.V. as against the indirectly obtained value 2.23 e.V. derived from the ionization potentials of  $\text{Cl}$  and  $\text{Cl}_2$  and the dissociation energy of  $\text{Cl}_2$ . From a consideration of electronic configuration for  $\text{Cl}_2^+$  molecule, Howell predicted that the transition involved corresponds to that observed for the neutral molecule. The ratio of the frequencies  $\omega'_e$  and  $\omega''_e$  being roughly half in the case of neutral molecule, he suggested that the frequencies  $\omega''_e$  and  $\omega'_e$  in the case of  $\text{Cl}_2^+$  should be of the order of 630 and 310  $\text{cm}^{-1}$ .

The authors<sup>4</sup> have recently reported the analysis of similar emission bands of bromine in the visible region as belonging to two systems, the ratio  $\omega'_e/\omega''_e$  for each of these being roughly equal to half. As these bands do not bear any relationship with the absorption bands of the neutral bromine molecule in the visible region, on experimental grounds, it may be concluded that the emitting molecule may be  $\text{Br}_2^+$  although a rotational analysis of the bands is necessary to confirm this view (Table I).

In the light of this work on bromine, and also Howell's predictions for  $\text{Cl}_2^+$ , the authors have attempted to reanalyse the emission bands of  $\text{Cl}_2^+$ . In addition to the data of Elliot and Cameron,<sup>2</sup> a number of new discrete bands observed by us especially on the longer wavelength have been utilised for this analysis. It was found that almost all the bands belong to four different systems. For three of these systems, the vibrational constants have been derived (Table II).

The first and the second systems are found to have a common lower level which is probably the ground state of the molecule. The

development of the fourth system is rather poor.

TABLE II

	$\omega'_e$	$x'_e\omega'_e$	$D'_e$	$\omega''_e$	$x''_e\omega''_e$	$D''_e$	$\nu_e$
System I	350.0	2.0	1.9	656.0	4.6	2.8	20448.0
System II	375.0	2.6	1.7	656.0	4.7	2.8	20736.0
System III	347.5	2.0	1.9	655.0	5.5	2.4	20569.0

The analyses have been confirmed by the following: (i) The vibrational assignments of the bands in the three systems are well supported by the chlorine isotope effect which can be seen from Table I. (ii) They are also consistent with the values of the rotational constants  $B'_e$  and  $B''_e$  derived by Elliot and Cameron.<sup>2</sup> (iii) The energy of dissociation of the ground state for  $\text{Cl}_2^+$ , from Birge-Sponer extrapolation method may be either 2.8 e.V. or 2.4 e.V. The indirectly determined value 2.23 e.V. mentioned above is thus of the right order of magnitude. (iv) The intensity distribution in the three systems is of the open Franck-Condon parabola type which is normally to be expected when the ratio  $\omega'_e/\omega''_e$  is approximately half.

Full details of the analyses and discussion on the electronic states are being published elsewhere.

Dept. of Physics, P. TIRUVENGANNA RAO.  
Andhra University, P. B. V. HARANATH.  
Waltair, September 1, 1955.

1. Uchida, Y. and Ota, Y., *Jap. J. Phys.*, 1928, **5**, 53.
2. Elliot, A. and Cameron, W. H. B., *Proc. Roy. Soc.*, 1937, **158A**, 681; *Ibid.*, 1938, **164**, 531.
3. Howell, H. G., *Proc. Phys. Soc.*, 1953, **66A**, 759.
4. Haranath, P. B. V. and Tiruvenganna Rao, P., *Indian J. Phys.*, 1955, **29**, 205.

ON THE DETERMINATION OF  
DIPOLE MOMENT AND RELAXATION  
TIME AT 3 Cm.

IN the 3 cm. region dipole moments and relaxation times are usually determined by measuring the variation of the loss,  $\tan \delta$ , with frequency in dilute solutions of polar substances in non-polar solvents. Potapenko and Wheeler<sup>1</sup> described a method by which these could be deduced from a study of the variation of the complex polarisation with concentration in a non-polar solvent at a single frequency and measured the relaxation times for fatty acids in dioxane at a wavelength of about 25 cm. A study of these two methods suggested the possibility of applying Potapenko and Wheeler's method in the 3 cm. region for the determination of  $\mu$  and  $\tau$  from measurements at a single frequency. The real and imaginary parts of the complex dielectric constant  $\epsilon' - i\epsilon''$  could be measured using waveguide techniques with a shorted cell.<sup>2</sup> The apparatus used is given in the block diagram below,

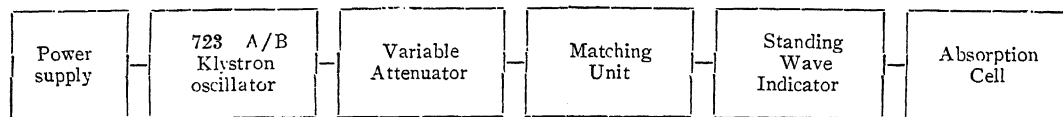


TABLE I

Compound	$\tau \times 10^{12}$ sec. (at 30° C.)	$\mu$	Literature values					
			$\tau \times 10^{12}$ sec. (20° C.)				$\mu$	
			(1)	(2)	(3)	(4)		
1 Nitrobenzene	..	15.5	4.4	13.0	11.6	11.5	..	3.90-4.3
2 Acetone	..	1.8	2.4	3.3	3.3	3.2	2.47	2.61-2.78
3 Benzophenone	..	8.9	2.5	18.1	16.4	22.0	16.1	2.95-3.13
4 Acetophenone	..	7.8	2.6	..	..	..	..	2.89-2.97

(1) Cripwell and Sutherland<sup>2</sup>; (2) Jackson and Powles<sup>3</sup>; (3) Whiffen and Thompson<sup>4</sup>; (4) Holzmüller.<sup>5</sup>

The polarisation values of  $P_r$  and  $P_a$  for infinite dilution are deduced graphically. The equations of Potapenko and Wheeler

$$\tau = (I/\omega) P_i / (P_r - P_a)$$

and

$$P_a = \frac{P_i^2 + (P_r - P_a)^2}{(P_r - P_a)}$$

where  $P_a$ , the orientation polarisation and  $P_a$ , the sum of the atomic and electronic polarisations, are used to calculate the dipole moment  $\mu$  and the relaxation time  $\tau$ . The final values are given in the table below together with the existing values in the literature<sup>2-5</sup> for com-

parison for nitrobenzene, acetone and benzophenone. The relaxation time for acetophenone is determined for the first time. Benzene is used as the solvent in all the measurements. The chemicals are all of the Analar standard of purity.

In view of the limited accuracy of the measurements at these wavelengths, the agreement with the literature values given in Table I may be considered satisfactory.

Full details will be published elsewhere.

CH. RADHAKRISHNA MURTY.

[D. V. G. L. NARASIMHA RAO.

Physics Dept.,  
Andhra University,  
Waltair, September 5, 1955.

1. Potapenko, G. and Wheeler (Jr.) D., *Rev. Mod. Phys.*, 1948, **20**, 143.
2. Cripwell, F. J. and Sutherland, G. B. B. M., *Trans. Farad. Soc.*, 1946, **42A**, 149.
3. Willis Jackson and Powles, J. G., *Ibid.*, 101.
4. Whiffen, D. H. and Thompson H. W., *Ibid.*, 114.
5. Von Werner, Holzmüller, *Physik. Z.*, 1937, **38**, 574.

DIELECTRIC PROPERTIES OF ETHYL  
ACETATE IN THE ULTRA HIGH  
FREQUENCY REGION

THE dielectric constant and loss tangent were determined for ethyl acetate over a wide range of temperatures and also over a frequency range from 400 Mc/s. to 800 Mc/s. for which data are not available. The output of a U.H.F. oscillator was fed to a short circuited coaxial line filled with the liquid at one end. By adopting the standing wave method suggested by Von Hippel,<sup>1</sup> the above measurements were

made for ethyl acetate. Tables I and II give the temperature variation of the dielectric constant and loss tangent at 800 Mc./sec. over a temperature range from 30–60° C. and the frequency variation at 30° C.

TABLE I

Temp. °C.	$\epsilon'$	Tan. $\delta$
30	5.91	.019
20	6.12	.021
10	6.36	.025
0	6.60	.029
-10	6.88	.036
-20	7.09	.053
-30	6.78	.087
-40	5.10	.161
-50	4.54	.088
-60	4.24	.051

TABLE II

Freq. Mc./s.	$\epsilon'$	Tan. $\delta$
900	5.90	.019
800	5.91	.019
700	5.93	.018
600	5.96	.017
500	5.98	.016
400	6.00	.014

The variation of the dielectric constant and loss with temperature in the dispersion region shows that the maximum absorption occurs at  $-40^\circ\text{C}$ . for 800 Mc/s. The relaxation time ( $\tau$ ) can then be calculated on the basis of the empirically modified Onsager theory,<sup>2,3</sup>

$$\omega\tau = (1 - \delta)$$

where  $\omega$  is the frequency at which the maximum absorption occurs and

$$\delta = \frac{1}{2} \beta (\epsilon_\infty + 2) (1 - q)$$

where  $q$  is Van Vleck empirical factor expressed in terms of the static and the optical values of the dielectric constant, and

$$\beta = 4\pi N\mu^2/9kT$$

where  $N$  is the number of molecules per c.c.,  $\mu$  the dipole moment,  $k$  the Boltzmann's constant,  $T$  the absolute temperature.

The values of  $\delta$  and relaxation time obtained are:

$$\delta = .2291. \quad \tau = 1.53 \times 10^{-10} \text{ (Temp. } -40^\circ\text{C.)}$$

Full details of the experimental work and an account of further work on dispersion in pure liquids which is in progress will be published elsewhere.

Microwave Lab., K. V. GOPALA KRISHNA.  
Andhra University,  
Waltair, September 13, 1955.

## STEEL TARGETS ATTACKED BY EXPLOSIVES WITH LINED CAVITIES

WHEN a 'Munroe' jet squirted from a high explosive charge with lined cavity impinges upon a target, it exerts a pressure of about a quarter million atmospheres and the target material flows plastically out of the path of the jet.<sup>1</sup> The changes in microstructure and hardness, and types of fracture observed in steel targets penetrated by Munroe jets are described below.

The metal in the jet spot-welds on the crater surface. The deposit of the steel jet on the crater surface (observed as martensitic regions) indicates that the metal in the jet had definitely attained a temperature more than  $A_{c3}$  point and then suddenly quenched. A shallow layer (0.3 mm.) of the metal of the original target at the surface of the crater got heated beyond  $A_{c1}$  point and was observed as martensitic grains surrounded by ferritic grains. The layers adjoining this region were severely cold worked.

The microstructure of the remaining low-carbon (0.13% C) steel target was characterized by the presence of Neumann bands or shock twins. The maximum number of twin directions in a single ferrite grain decreased with distance from the crater profile. It is interesting to note that Evans and Taylor<sup>2</sup> also observed Neumann bands in Armco steel targets penetrated by steel jets. In medium-carbon (0.4% C) steel targets,<sup>3</sup> Neumann bands were not observed and the microstructure was characterized by severe grain distortion and flow, which also decreased with distance from the crater profile.

The hardness measurements taken along a radius of a circular cross-section of the low-carbon steel target showed an abrupt drop in hardness near the profile of the crater and a series of plateaus along which the hardness remained constant in each hardness *versus* distance curve. No such plateaus of constant hardness were observed in medium-carbon steel targets.

Shear fractures at approximately  $45^\circ$  to the circumference of the crater were also observed. Due to the high pressure in the crater, the metal in the jet was forced into the shear fractures.

The above observations indicate that it is possible to work-harden steel by explosives with lined cavities and also to spot-weld one metal on another. A full paper (by Singh, Krishnaswamy and Soundraraj) will be published shortly.

1. Roberts, S. and Von Hippel, A., *J. Appl. Phys.*, 1946, **17**, 610.
2. Cole, R. H., *J. Chem. Phys.*, 1938, **6**, 385.
3. Saxton, J. A., *Proc. Roy. Soc.*, 1952, **213A**, 475.

The author is grateful to Professor D. S. Kothari for his interest and encouragement. Thanks are also due to Mr. N. R. Krishnaswamy and Mr. A. Soundraraj for their help in this work.

Defence Science Lab., SAMPOORAN SINGH.  
Ministry of Defence,  
New Delhi, October 30, 1955.

1. Birkhoff, G., MacDougall, D. P., Pugh, E. M. and Taylor, G. I., *J. Appl. Phys.*, 1948, **19**, 563.
2. Evans, W. M. and Taylor, G. I., *Research*, 1952, **5**, 502.
3. Singh, S. and Gandhi, P. N., *Ibid.* (in press).

### ELASTIC CONSTANTS OF THALLIUM ALUM

ALUMS form an important group of cubic crystals which can be readily grown from aqueous solutions. The photoelastic behaviour of ammonium, chromium, potassium and thallium alums has been studied by Bhagavantam and co-workers.<sup>1</sup> The behaviour of thallium alum was observed to be quite different from that of other alums in that the photoelastic constant,  $q_{44}$ , of this substance is positive while the rest have a negative  $q_{44}$ . Elastic constants of ammonium potassium and chromium alums have been determined by Sundara Rao<sup>2</sup> and there is no data available in literature regarding the elastic behaviour of thallium alum. In the present investigation, elastic moduli ( $s_{ij}$ ) of thallium alum have been determined using the composite piezoelectric oscillator method due to Balamuth<sup>3</sup> and Rose.<sup>4</sup>

Specimen cylinders with their lengths along [100] and [111] directions are cut from a well-developed crystal grown in this laboratory. Young's modulus and rigidity modulus of these cylinders are determined in the frequency range 100-150 kc./s. and the elastic moduli are evaluated in the usual manner.

The results are given in Table I along with the data regarding the elastic behaviour of other alums. Elastic moduli are given in the units of  $10^{-13}$  cm.<sup>2</sup> dyne<sup>-1</sup>. Density of thallium alum = 2.32 g./cm.<sup>3</sup>

TABLE I

Substance	$s_{11}$	$-s_{12}$	$s_{44}$
Potassium Alum ..	51.8	15.3	116
Ammonium Alum ..	53.5	15.9	125
Chromium Alum ..	54.2	15.3	130
Thallium Alum ..	49.0	15.5	115

As can be seen from Table I, thallium alum falls in a line with other alums in its elastic behaviour.

The author expresses his grateful thanks to Professor S. Bhagavantam for his guidance and encouragement during the course of this work.  
Physical Labs., S. V. SUBRAHMANYAM.  
Osmania University,  
Hyderabad, December 6, 1955.

1. Bhagavantam, S. and Krishna Rao, K. V., *Curr. Sci.*, 1954, **23**, 257.
2. Sundara Rao, K. V. G., *Ibid.*, 1947, **16**, 91.
3. Balamuth, L., *Phys. Rev.*, 1934, **45**, 715.
4. Rose, F. C., *Ibid.*, 1936, **49**, 50.

### WATER-MASSSES IN THE BAY OF BENGAL

THE earlier studies of water types in the Bay of Bengal were confined to the lower half of the Bay<sup>1</sup> and these do not appear to have been pursued after 1938. The classification of water-masses having definite limits of temperature and salinity has since become more comprehensive and includes new types.<sup>2</sup> In view of this a beginning was made towards a detailed survey of water-masses in the Bay.

With the co-operation of the Defence Ministry, the Andhra University arranged ocean cruises using Indian Navy Minesweepers for different studies relating to Bay of Bengal waters. During these cruises vertical temperature and salinity were taken at 21 stations along the east coast between Madras in the south and Swatch Of No Ground in the north. The study of water-masses in the western Bay was taken up during the Cruise No. 12 which was arranged from 4th to 6th March 1953. For this the requisite temperature and salinity data were selected at eight of the deeper serial stations. The temperature measurements were made with reversing thermometers and the salinity values are obtained by first determining the chlorinity of the samples, collected by Nansen bottles, by titration against standardised silver nitrate solution and then referring to Knudsen's tables. The investigation was confined to waters off the central east coast and observations made down to a depth of 500 metres wherever possible.

The surface and near-surface water-masses have recently been described.<sup>3</sup> The names chosen for the shallow water-masses under study are those adopted by La-Fond<sup>3</sup> and are based on their origin, distribution, and formation. Their



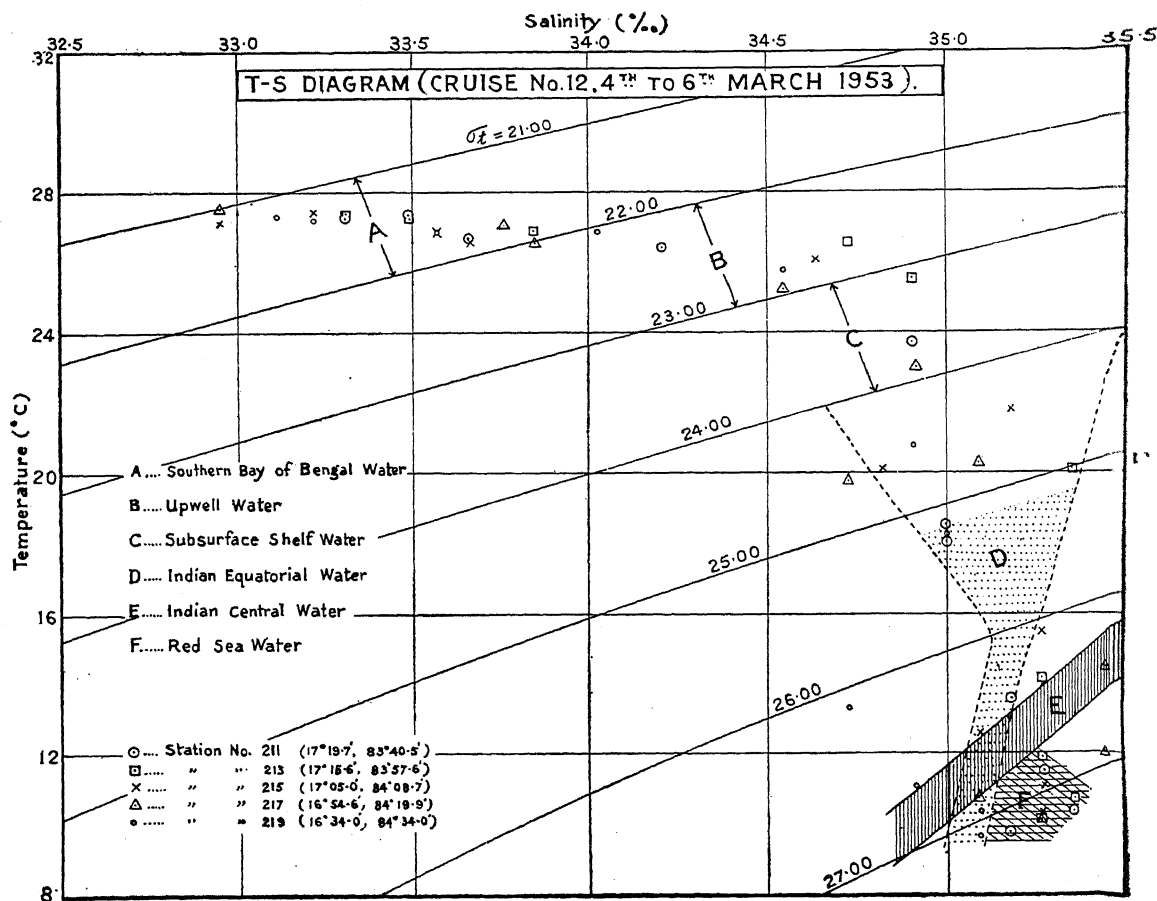
designation is according to their density or  $\sigma_t$ . For example, the high-temperature low-salinity water having a  $\sigma_t < 19.00$  is called Northern Dilute Water;  $\sigma_t = 19.00-21.00$  Transition Water;  $\sigma_t = 21.00-22.00$  Southern Bay of Bengal Water;  $\sigma_t = 22.00-23.00$  Upwell Water; and  $\sigma_t = 23.00-24.00$  Subsurface Shelf Water.

The Northern Dilute Water is formed in the northern part of the Bay of Bengal and is comprised of a large quantity of fresh-water discharged by the great rivers in that region. The heavier Southern Bay of Bengal Water is characteristic of the water at the surface at the south end of the Bay. Mixtures of the two are usually found somewhere in the Bay. The Upwell Water is found in spring adjacent to the coast, having upwelled from subsurface layers. The other still heavier water-masses never reach the surface.

The temperature and salinity limits vary widely in the surface layers, but must fall within the assigned  $\sigma_t$  limits. However, the

conventional deeper water-masses in the Indian Ocean<sup>2</sup> are more uniform having more restricted ranges of temperature and salinity. They are called Indian Equatorial Water, Indian Central Water, Red Sea Water, Antarctic Intermediate Water, Subantarctic Water, Circumpolar Water, and Antarctic Bottom Water.

On examination of the T-S diagrams (Fig. 1), constructed from the data collected in March 1953, the water-masses present can be identified. In this month the current off the east coast is flowing to the north-east. The Northern Dilute and Transition Water are not present now, having been dissipated by mixing with heavier water. The top stratum which extends down to 90 meters is composed of Southern Bay of Bengal and Upwell Water. Between 90 and about 160 meters is found the Subsurface Shelf Water and the Upper Limit of Indian Equatorial Water. The depths of the water-mass layers depend upon distance from shore and season.



The deep water-masses present, in addition to Indian Equatorial Water, appear to be Indian Central Water and Red Sea Water as shown in the figure by shaded bands.

The results arrived at are to be treated as tentative and more data are required to state precisely the nature of water-masses present and their characteristics. Study of the deeper waters is also called for, to understand more about the structure and circulation of the waters in the deeper layers.

The author is thankful to Prof. E. C. La Fond for guidance in the work.

Andhra University, C. POORNACHANDRA RAO.\*  
Waltair, October 3, 1955.

1. Sewell, R. B. Seymour. *Memoirs of the Royal Asiatic Society of Bengal*. 1938, 9, 357.
2. Sverdrup, H. U., *Oceanography for Meteorologists*, 1942, 159.
3. La Fond, E. C., *Andhra University Memoirs*, 2 (in press).

\* Now with India Meteorological Department, Poona 5.

## NUCLEAR SCATTERING OF HIGH ENERGY ELECTRONS BY LIGHT ELEMENTS

THE nuclear elastic scattering of 125 Mev. electrons by beryllium has been observed by Hofstadter, Fechter and McIntyre,<sup>1</sup> while that of 190 Mev. electrons by beryllium has been observed by McIntyre, Hahn and Hofstadter.<sup>2</sup> Advani, Shah and Gatha<sup>3</sup> have correlated these experimental relative differential scattering cross-sections on the basis of a characteristic nuclear form factor given by

$$g(\vec{s}) = a_1 \exp(-\beta_1 \vec{s}^2) + a_2 \exp(-\beta_2 \vec{s}^2) \{1 - \beta_3 \vec{s}^2 + \beta_4 \vec{s}^4\} \quad (1)$$

where

$$\begin{aligned} a_1 &= 0.0022 \text{ mb.}, \quad a_2 = 0.0078 \text{ mb.} \\ \beta_1 &= 0.29 \times 10^{-26} \text{ cm.}^2, \quad \beta_2 = 0.23 \times 10^{-26} \text{ cm.}^2 \\ \beta_3 &= 0.04 \times 10^{-26} \text{ cm.}^2; \quad \beta_4 = 0.0075 \times 10^{-52} \text{ cm.}^4 \end{aligned}$$

The above theoretical characteristic form factor has been obtained from the characteristic nuclear density distribution determined by Gatha and Shah,<sup>4</sup> on the basis of the nuclear scattering of 340 Mev. protons. Recently Fregeau and Hofstadter<sup>5</sup> have observed the nuclear elastic scattering of 187 Mev. electrons by carbon. The theoretical consequences of these observations have been considered in the present investigation.

It may be noted that the experimental observations on beryllium provide only the rela-

tive values of the differential cross-sections, while the experimental observations on carbon provide the absolute values for the same. Therefore, while the experimental values of  $g(\vec{s})$  for beryllium are relative, those for carbon are absolute. It has been shown by Advani, Shah and Gatha<sup>3</sup> that the experimental relative  $g(\vec{s})$  for beryllium can be made to agree with the theoretical  $g(\vec{s})$  after suitable normalization. The experimental absolute  $g(\vec{s})$  for carbon can also be made to agree with the theoretical  $g(\vec{s})$  by an appropriate renormalization. The theoretical  $g(\vec{s})$  and such normalized experimental  $g(\vec{s})$  are shown in Fig. 1 as represented by Curve A and the corresponding experimental points. It is clear that a satisfactory agreement, between the theoretical and normalized experimental  $g(\vec{s})$ , has been obtained. However, such a renormalization of the experimental absolute  $g(\vec{s})$  for carbon presupposes that the original normalization is incorrect. In view of the original normalization process, used by Fregeau and Hofstadter,<sup>5</sup> such an assumption appears untenable.

Assuming that the original normalization of experimental  $g(\vec{s})$  for carbon is correct, the experimental relative  $g(\vec{s})$  for beryllium have been normalized again so as to make all the experimental values of  $g(\vec{s})$  to lie on a smooth curve. Such a curve, together with these values of experimental  $g(\vec{s})$ , are also shown in Fig. 1 by the curve B and the corresponding experimental points. It may be noted that the theoretical value of  $g(0)$  is determined, irrespective of the nature of the charge density distribution, on the basis of its normalization only.

It is clear that  $g(\vec{s})$ , represented by curve A, is due to a characteristic nuclear proton density distribution which has been assumed to have the same form as the characteristic nuclear density distribution for nucleons. On the other hand, the  $g(\vec{s})$  represented by curve B, must be regarded as due to a characteristic nuclear proton density distribution which may not have the same form as the characteristic nuclear density distribution for nucleons. It is considered unlikely at this stage, that the difference between  $g(\vec{s})$  of curve A and  $g(\vec{s})$  of curve B can be ascribed to any error in the determination of the characteristic nuclear density distribution for nucleons by Gatha and Shah.<sup>4</sup> Thus, one has to ascribe this difference to an inherent difference in the characteristic nuclear proton density distribution and the characteristic nuclear density distribution for nucleons. This would mean that the characteristic nuclear

proton density distribution is different from the characteristic neutron density distribution for light elements.

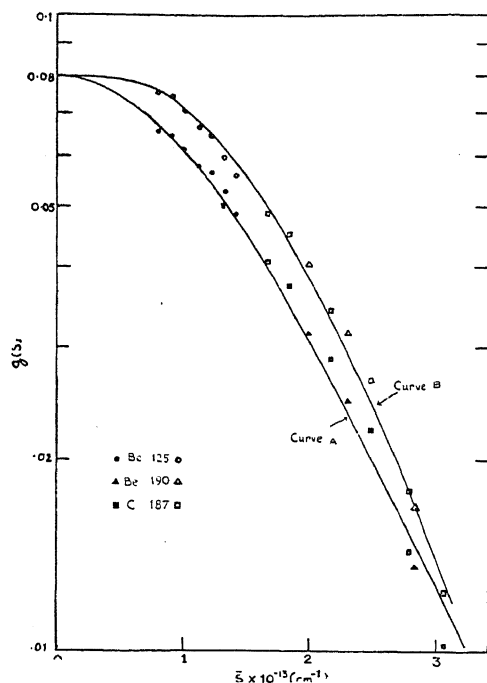


FIG. 1. Curve A represents theoretical  $g(\xi)$  while the full points represent the experimental  $g(\xi)$  normalized to it; Curve B represents experimental  $g(\xi)$  normalized to carbon data while the open points represent the experimental  $g(\xi)$  normalized to the same.

It may be noted that the form factor  $g(\xi)$  for a point nucleus would be represented by the constant value  $g(\xi) = 0.8$ . Any deviations of  $g(\xi)$  from this value must be regarded as due to the nature of the nuclear proton density distribution. It is clear that for small values of  $\xi$ ,  $g(\xi)$  of curve B deviates much less from this value than the  $g(\xi)$  of curve A. It may also be noted that, in the Born approximation,  $g(\xi)$  for small  $\xi$  arises from the characteristic nuclear proton density distribution at large distances from the centre of the nucleus. Therefore, one can conclude that the actual characteristic nuclear proton density distribution becomes negligible at smaller radial distances from the nuclear centre than the characteristic nuclear density distribution for neutrons. Therefore, the characteristic nuclear neutron density distribution predominates over the characteristic nuclear proton density distribution near the nuclear periphery. This conclusion agrees with that drawn by Johnson and Teller<sup>6</sup> on the basis of the

nuclear  $\beta$ -stability. However, the conclusion arrived at in the present investigation should be regarded as tentative until confirmed by further experimental data and their analysis.

Physics Dept., (Miss) M. K. ADVANI.  
Institute of Science, K. M. GATHA.  
Mayo Road, Bombay-1,  
December 13, 1955.

1. Hofstadter, R., Fechter, H. R. and McIntyre, J. A., *Phy. Rev.*, 1953, **92**, 978.
2. McIntyre, J. A., Hahn, B. and Hofstadter, R., *Ibid.*, 1954, **94**, 1084.
3. Advani, M. K., Shah, G. Z. and Gatha, K. M., *Curr. Sci.*, 1955, **24**, 367.
4. Gatha, K. M. and Shah, G. Z. (Private Communication).
5. Fregeau, J. H. and Hofstadter, R., *Phy. Rev.*, 1955, **99**, 1503.
6. Johnson, M. H. and Teller, E., *Ibid.*, 1954, **93**, 357.

### OCCURRENCE OF LIGNITIC MATERIAL IN THE GODAVARI DELTA

THE Government of Andhra have financed a project for the preliminary investigation of the occurrence of natural gas in parts of the Godavari Delta. Four bore-holes have been put down at Pedapatna Agraharam (150'), Vadrevupalle (100'), Amalapuram (200') and Thatipaka (325'), in the East Godavari District, between May and November 1955. Alternating layers of unconsolidated sand and clay were observed with occasional intercalations of partially decomposed vegetable matter. In the bore-hole at Thatipaka, blackish-brown fragments of low specific gravity (lighter than ordinary black clay) resembling peaty or lignitic material, were obtained at depths of 245' and 255'. The sample was analysed and the proximate analysis is given in column 1 of Table I. The usual range in composition of lignites, as specified by the U.S. Bureau of Mines, is also given alongside for comparison (col. 2).

TABLE I

	1	2
Moisture	.. 16.13 %	23.20-40.00 %
Volatiles	.. 40.05 %	23.80-51.00 %
Ash	.. 15.50 %	4.20-15.80 %
Fixed Carbon	.. 28.32 %	20.90-35.00 %

1. Analysis of Sample from Thatipaka, by T.V.S.R. Kshira Sagar. 2. Quoted from *Investigation of Preparation and Use of lignite*. U.S. Bureau of Mines, 1918-25, p. 86.

It can be seen from the table that the composition of the analysed sample falls well within the range of lignites but for the moisture content, which appears to be rather low. Detailed work on the nature of the sediments in the delta area is under progress.

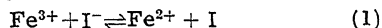
The authors are grateful to Dr. V. S. Krishna for encouragement, to Professor C. Mahadevan and Dr. A. N. Rao for guidance and criticism and to Dr. M. N. Rao for help.

T. V. S. R. KSHIRA SAGAR.  
B. B. G. SARMA.

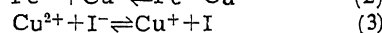
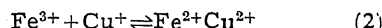
Dept. of Geology,  
Andhra University,  
Waltair, December 29, 1955.

### ON THE ESTIMATION OF IRON BY IODOMETRY

THE overall reaction involved in the estimation of iron by iodometry is represented by



A common practice<sup>1</sup> is to use suspensions of  $\text{Cu}_2\text{I}_2$  to catalyse the liberation of iodine. The use of this catalyst in effect provides an alternative mechanism in eliminating or modifying any of the steps suggested by Fudge and Sykes.<sup>2</sup> As a matter of fact, it can be noticed that on addition of a small quantity of  $\text{Cu}_2\text{I}_2$  to the solution of ferric salt, iodine is liberated and a transparent solution is obtained. Evidently the reactions



come into play. The full implication of reaction (2) in the ferric iodide reaction as well as in the oxidation of HI in the solution phase<sup>3</sup> will be published in due course.

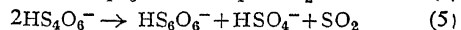
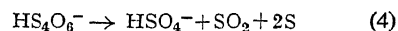
In spite of extensive investigation,<sup>4-8</sup> this method still presents difficulties preventing its wide application. We prescribe the conditions for an accurate estimation of iron present in solution as chloride, nitrate, perchlorate and even as sulphate, upto 0.3 molar concentration of  $\text{Fe}^{3+}$  having corresponding initial acid strength of 0.1 N. Use of  $\text{HClO}_4$  has been recommended as  $\text{HNO}_3$  and  $\text{HCl}$  often contain impurities that affect the accuracy of the result. Complex formation with  $\text{Cl}^-$  and  $\text{SO}_4^{2-}$  ions do not affect the accuracy of the method. The reaction is complete within 2 minutes at room temperature. The necessity of using any catalyst or maintaining  $\text{CO}_2$  atmosphere does not arise.

In consideration of the observation of Kiss and Bossanyi<sup>9</sup> and the various side equilibria inherent in the system, we have so adjusted

the concentrations of  $\text{H}^+$  and  $\text{I}^-$  such that for a range of  $\text{Fe}^{3+}$  ion concentration iodometry can give satisfactory results.

To 25 c.c. of the solution of the ferric salt of strength ranging from 0.1-0.3 M containing initially 0.1 N acid, 2 c.c. of 6 N  $\text{HClO}_4$  and 4 g. of solid KI are to be added. The titration is to be carried out as usual with 0.1 N  $\text{Na}_2\text{S}_2\text{O}_3$  solution using starch as indicator. The end point is sharp and after-blueing does not occur for days. For solutions of low  $\text{Fe}^{3+}$  content, the amount of solid KI should be maintained while 1 c.c. of acid is to be added and titration with 0.05 N or 0.025 N solution of  $\text{Na}_2\text{S}_2\text{O}_3$  as necessary may be carried out. After-blueing of starch would not occur for at least 20 minutes, though the time allowed for the liberation of iodine is 2 minutes and that for titration 3-4 minutes.

The non-occurrence of after-blueing has been found to be dependent on the concentration of  $\text{HS}_4\text{O}_6^-$  which gives  $\text{SO}_2$  on decomposition. Of the following two reactions



We are of opinion that reaction (5) takes place predominantly in the presence of  $\text{Fe}^{2+}$  and HI in the system as sulphur does not appear in any considerable quantity. The formation of  $\text{SO}_2$  does not allow the appearance of after-blueing. With lapse of time, when the decomposition is either complete or the rate of aerial oxidation of  $\text{Fe}^{2+}$  and HI is greater as compared to the combined rate of reactions (4) and (5) that the after-blueing appears. The iodometric method of estimation entails various factors contributing to positive and negative errors,<sup>3</sup> but the procedure prescribed above gives results which are as accurate as obtained by dichromate method using N-phenyl anthranilic acid as indicator.

Dept. of Chemistry,  
Ravenshaw College,  
Cuttack-3,  
October 7, 1955.

D. PATNAIK.  
G. MAHAPATRA.  
A. CHIRANJEEBI.

1. Vogel, A. L., *Text Book of Quantitative Analysis*, 1946 Edn., 436.
2. Fudge, A. J. and Sykes, K. W., *J. Chem. Soc.*, 1952, 119.
3. Patnaik, D. and others, to be published.
4. Hahn, F. and Windisch, H., *Ber.*, 1923, 56B, 598.
5. Kolthoff, I. M., *Pharm. Weekblad.*, 1921, 58, 1510.
6. Bottger, K. and Bottger, W., *Z. Anal. Chem.*, 1927, 70, 214.
7. Swift, E. H., *J. Amer. Chem. Soc.*, 1929, 51, 2682.
8. Grey, F. C., *J. Chem. Soc.*, 1929, 35.
9. Von Kiss, A. and Bossanyi, I., *Z. Anorg. Chem.*, 1930, 191, 289.

### BENZOIN CONDENSATION OF SALICYL ALDEHYDE

SALICYLALDEHYDE has been treated with potassium cyanide in ethyl alcoholic solution, using the usual proportions.<sup>1</sup> Contrary to expectations, salicylaldehyde also appears to undergo the benzoïn condensation. The reaction proceeds smoothly, even at room temperature and within half an hour (usually benzoïn formation requires refluxing for about 1½ hours on a steam-bath), the colour changing through yellow and orange to brown product obtained by refrigeration. The benzoïn when purified by recrystallisation from alcohol and acetic acid, yielded reddish brown needles, m.p. 148-50° C., decomposing at 186-88° C. (Found: C, 68.7; H, 4.8;  $C_{14}H_{12}O_4$  requires C, 68.85; H, 4.92.)

The easy synthesis of this benzoïn is probably due to the ortho-effect operating in salicylaldehyde, which, aided by the electrometric effect, facilitates the release of proton. This work was conducted at the R.P.D. College, Belgaum.

Technical Dept.,  
Stan-Vac Refineries, Bombay,  
October 27, 1955.

R. J. PHADKE.

1. *Organic Reactions*, Edited by Roger Adams (John Wiley), 1948, 4.

### PEROXY TITANIUM OXALATE

MAZZUCHELLI AND PONTANELLI<sup>1</sup> prepared a peroxy titanium complex of the formula  $Ti_2O_3(C_2O_4)_2$  which can be considered as a derivative of  $Ti_2O_5$ , but the normal peroxy titanium oxalate ( $TiO_2C_2O_4$ ) has not been prepared so far. The work carried out in this laboratory has yielded practically pure peroxy oxalate as outlined below.

The slurry of freshly precipitated titanic acid was mixed with excess of hydrogen peroxide and oxalic acid in the molar ratio of 1:3:3 when a red solution was obtained. This solution was evaporated by passing dry air when oxalic acid crystals separated. The mother liquor on further concentration yielded an orange-red amorphous solid which was washed with absolute alcohol to remove the uncombined oxalic acid and hydrogen peroxide. The washed product was then dried free of alcohol by dry air and analysed for titanium, oxalate, peroxy oxygen and water. The titanium, oxalate and water contents were determined by combustion method while peroxy oxygen was determined by treating the substance with acidified potassium iodide and estimating the

iodine liberated. The analyses of the samples prepared in this way are given in Table I.

TABLE I

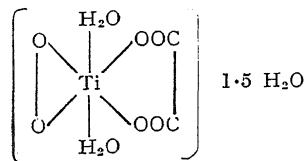
Experiment No.	Reactants in the aqueous mixture (mole ratio)			Molar composition of the complex					
	Ti(OH) <sub>4</sub>	H <sub>2</sub> O <sub>2</sub>	H <sub>2</sub> C <sub>2</sub> O <sub>4</sub>	Ti	O*	C <sub>2</sub> O <sub>4</sub>	Of	H <sub>2</sub> O	
1	1	2.90	2.92	1.00	1.00	1.10	0.98	3.40	
2	1	2.98	3.00	1.09	1.00	1.10	0.97	3.42	
3	1	3.02	3.10	1.08	1.00	1.09	0.93	3.40	
4	1	2.00	2.90	1.52	1.00	1.51	1.41	5.50	
5	1	0.62	2.90	2.09	1.00	2.03	1.95	6.68	

\* Peroxy oxygen by KI method; † Oxygen by difference.

The results of Table I (Expts. 1 to 3) show that the composition of the complex is practically  $TiO_2C_2O_4 \cdot 3.5H_2O$  when three moles of  $H_2O_2$  are employed. It is further seen that when the amount of hydrogen peroxide in the starting solution is less (Expts. 4 and 5) complexes of the formulae  $Ti_{1.5}O_{2.5}(C_2O_4)_{1.5} \cdot 5.5H_2O$  and  $Ti_2O_3(C_2O_4)_2 \cdot 7H_2O$  are obtained. The latter complex is identical with the complex prepared by Mazzucchelli and Pontanelli.<sup>1</sup> Thus it is essential to maintain high concentration of  $H_2O_2$  to get the normal peroxy complex  $TiO_2C_2O_4 \cdot 3.5H_2O$ .

Physico-chemical studies like molecular weight, conductivity, vapour pressure, absorption spectra, potentiometric titration against alkali, dehydration and decomposition under reduced pressure, show that the complex  $Ti_2O_3(C_2O_4)_2$  and other complexes of lower peroxy oxygen content are mixtures of  $TiO_2C_2O_4$  and  $TiOC_2O_4$ . The molecular weights of the complexes (Expts. 1 to 3) were found to be  $230 \pm 4$  by the freezing point method. The average dissociation constant for the normal peroxy complex as found by the conductivity method was  $4.5 \times 10^{-2}$ . The determination of aqueous tension at different temperatures gave a value of 15.39 k. cal./mole for the heat of dissociation of the complex. The complex has a characteristic absorption maximum at 425 mμ. Potentiometric titrations show that the complex is dibasic. Dehydration of the complex shows that out of 3.5 moles of water, 2 moles are not removed by dehydration in vacuum over  $P_2O_5$ . The complex loses active oxygen on storage. From the physico-chemical studies

indicated above it is concluded that the formula of the complex is



The authors are grateful to Prof. K. R. Krishnaswami and Dr. M. R. A. Rao for their keen interest and advice.

Dept. of Gen. Chem., D. P. KHARKAR.  
Indian Inst. of Sci., C. C. PATEL.  
Bangalore-3, November 22, 1955.

I. Mazzucchelli, A. and Pontanelli, *Atti. Accad. Lincei*, 1908, 18 (1), 518.

#### ANTIBIOTIC PRINCIPLE OF THE LEAVES OF *WITHANIA SOMNIFERA*\*

DURING a routine screening of Indian medicinal plants used in *Ayurveda* for the treatment of bacterial infections, it was found that the roots and leaves of *Withania somnifera* (Sanskrit: *Aswagandha*) exhibited marked activity against *S. aureus*. Alcoholic extract of the fresh leaves showed much more activity than the roots and was therefore taken up for detailed investigation. The ground root and leaves are in use in *Ayurveda* among its many other applications, for the treatment of carbuncles, ulcers and painful swellings. An essential oil, ipuranol, a crystalline alcohol withaniol, hentriacontane, phytosterols and fatty oils are known to be present in the plant along with 3 alkaloids one of which somniferin  $\text{C}_{12}\text{H}_{16}\text{N}_2$ , is crystalline.<sup>1</sup>

Fresh leaves were extracted at room temperature with absolute alcohol for 24 hours, and the extract evaporated to dryness in a desiccator over anhydrous calcium chloride in the refrigerator. The residue was taken up first in small quantities of acetone and then with absolute alcohol and the two extracts combined. A resinous material, insoluble in both these solvents, was left behind, which was devoid of any activity. A small quantity of the solution which contained the activity was spotted on a strip of Whatman No. 1 filter-paper, 30 cm.  $\times$  2.5 cm. and a chromatogram run at 0°C. by the ascending method, using ether saturated with water, as the solvent system. The chromatogram was dried at room

temperature, cut into smaller bits (both horizontally and vertically in the middle) and put on seeded agar plates (seeded with a 24-hour-old culture of *S. aureus*) and incubated at 37°C. for 18 hours. A duplicate chromatogram was also run under identical conditions, dried and kept apart. There were two zones of inhibition on the seeded agar plate, one of smaller activity (diameter of the zone of inhibition was 8 mm.) with very low Rf value (0.06) and the other of marked activity (diameter of the zone of inhibition was 40 mm.) with an Rf value of 0.786 (Fig. 1).

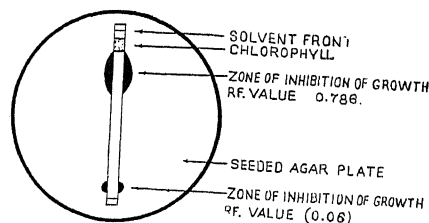


FIG. 1

The portions corresponding to the two active zones were cut off in the duplicate chromatogram, eluted separately with a mixture of acetone and alcohol (1:1). The solutions showed negative test with alkaloidal reagents (potassium mercuric iodide and tannic acid; a drop of the reagent was mixed with a drop of the solution on a slide and examined under the microscope) thus showing that the activity is not associated with any alkaloids of the plant.

The more active substance (Rf value 0.786) was isolated from the alcoholic extract of the leaves in a chemically pure state. It was a pale yellow crystalline solid (yield: 5 mg. from 100 g. of fresh leaves) melting at 213-15°C., soluble in alcohol, acetone, benzene and ether; neutral to litmus and gave a yellowish colouration with ferric chloride solution. It completely inhibited the growth of *S. aureus* (strain obtained from the Central Institute of Research, Kasauli and maintained in our laboratory) at a dilution of 1 in 600,000 when assayed by serial dilution method using buffered nutrient broth (phosphate buffer of pH 7), while there was partial inhibition of growth even at 1 in 1,000,000. A dilution of 1 in 1,000 of a 24-hour-old culture was used. The substance was not inactivated by heat. It was more stable on the acid side, but was slowly inactivated on the alkaline side. Details of the method of isolation and other data are being published

\* Published with the kind permission of the Governing Body, C.I.R.I.S.M.

elsewhere. Detailed investigations on this substance are in progress.

My sincere thanks are due to Dr. C. G. Pandit and Dr. P. M. Mehta for their keen interest in this work.

Dept. of Biochemistry, P. A. KURUP.  
Central Inst. of Research,  
Indigenous Systems of Medicine,  
Jamnagar, December 5, 1955.

1. Mukerji, B., *The Indian Pharmaceutical Codex*, 1953, 1, 253.

### DILUTORS FOR BUFFALO SEMEN

ONE of the major problems confronting efficient utilisation of buffalo semen on a large scale is the difficulty of its preservation *in vitro* for long periods. Studies on the evolution of a suitable extender for buffalo semen are being carried on in our laboratory for sometime. A note on the use of the active principle instead of the whole egg-yolk was communicated in these columns earlier.<sup>1</sup> Subsequent researches have revealed certain inherent difficulties in the general use of the active principle as a substitute of egg-yolk. First is the cost, and second the loss of activity of the separated powder under purification and storage.

Recently, a detailed study was undertaken with six dilutors. They were: (i) *active principle* (PA), (ii) *egg-yolk phosphate* (EyP), (iii) *egg-yolk citrate* (EyC), (iv) *autoclaved milk* (AM), (v) "*Spermasol*" (S)—a proprietary product of Messrs. H. Mack of Illertissen, W. Germany, and (vi) *glucose-soda bicarbonate-sulphamezathine* (I.C.I.)-egg-yolk (G). Kumaran<sup>2</sup> used a dilutor similar to (vi) but containing sulphamethazine (Sulphadimidine sodium 16% W/V solution). Preliminary trials showed that the dilutor so prepared was in no way better than (iii), i.e., EyC. The poor keeping quality of Kumaran's dilutor might be due to the high pH value (10.5 to 11) of the sulphamethazine sodium solution added to the dilutor, whereas aq. solution of the powder form at 37° C. gave a pH of 6.65. The dilutor used by the authors contained sulphamezathine (I.C.I., sulphadimethylpyrimidine) in the powder form. It contained four parts of 5% glucose containing 2g. sulphamezathine (I.C.I.) per 100 ml. + 1 part of 1.3% soda bicarbonate solution + 1 part of egg-yolk. The rest of the dilutors were prepared as usual except "*Spermasol*" which was prepared as per directions accompanying the ampoules. The rate of dilution was kept constant (1:5).

The results obtained are given in Table I. Only ejaculates showing not less than 90% live spermatozoa were used for the trials. A given sample of semen was divided among the dilutors and per dilutor two sub-samples were run. The diluted samples were maintained in thermos flasks at 4° C. for 8 days and the percentage of motile spermatozoa was estimated in a haemocytometer at 37° C. by using a microscope equipped with a thermostage.

TABLE I

Dilutor	Bull No.	No. of ejaculates tested	No. of ejaculates in which all sperm died on the 8th day	Average % of live sperm
PA	28	5	4	1.0
	33	5	3	1.3
	24	6	4	10.9
	25	3	2	2.1
	Total	19	13	3.8 (Av.)
EyP	28	5	4	5.0
	33	5	4	6.7
	24	6	3	10.5
	25	3	2	3.0
	Total	19	13	6.3 (Av.)
EyC	28	5	3	9.7
	33	5	3	19.0
	24	6	1	27.2
	25	3	1	21.2
	Total	19	8	19.3 (Av.)
AM	28	5	2	15.5
	33	5	3	1.0
	24	6	4	15.1
	25	3	2	13.6
	Total	19	11	11.3 (Av.)
S	28	5	1	16.7
	33	5	0	36.2
	24	6	1	30.3
	25	3	0	30.5
	Total	19	2	28.4 (Av.)
G	28	5	0	16.6
	33	5	0	49.7
	24	6	2	22.0
	25	3	0	42.2
	Total	19	2	32.6 (Av.)

From Table I, it is clear that among the dilutors for buffalo semen tried, G is the best followed in order of decreasing suitability (on efficiency) by spermasol, EyC, AM, EyP and PA. Further, the results indicate a bull to bull variation in the "preservation index" by which is meant the capacity to survive *in vitro*.

Fertility trials carried on under controlled conditions revealed rates as favourable with 'G' as with EyP/EyC. However, further trials are considered necessary to confirm this finding.

Recently, preliminary trials carried out with 'G' and glycine egg-yolk dilutor developed by Roy and Bishop<sup>3</sup> showed that the latter was not superior to the former as far as buffalo semen *in vitro* was concerned. Twelve ejaculates from two buffalo bulls preserved in G and glycine egg-yolk dilutor showed average motility ratings of  $2.38 \pm 0.31$  and  $2.38 \pm 0.18$  respectively after a lapse of 7 days. Further work is in progress.

We are thankful to Messrs. Mack & Co., for the supply of Spermasol for trials.

Animal Genetics Division, P. N. SRIVASTAVA.  
I.V.R.I., Izatnagar, U.P., S. S. PRABHU.  
August 19, 1955.

1. Srivastava, P. N., *et al. Curr. Sci.*, 1953, **22**, 152.
2. Kumaran, J. D. S., *Indian Farming*, 1953, **2** (10), 1.
3. Roy, A. and Bishop, M. W. H., *Nature*, 1954, **174**, 746.

#### A NEW REAGENT FOR GRAVIMETRIC ESTIMATION OF IRON

THE use of diphenyl thio-violuric acid for the gravimetric estimation of copper was reported by the author in two communications recently.<sup>1,2</sup> In the course of the present investigation, it was found that this reagent can also be used for the gravimetric estimation of iron. Iron can be estimated both in ferrous and ferric condition by this reagent, two different compounds being precipitated in the two cases.<sup>3</sup> For these estimations, the ammonium salt of diphenyl thio-violuric acid was used.

With the pH controlled between 4.9 and 5.6 in the case of ferrous iron and 4.9 and 5.8 in the case of ferric iron, an excess of the reagent was added (thrice the amount with ferrous and twice with ferric). Complete precipitation could be effected after warming the reagents together on a water-bath for an hour and leaving the product overnight. Filtration through sintered crucibles (porosity 4) and drying at 110° gave constancy of results with an accuracy of 0.2-0.3%.

Dept. of Chemistry,  
University of Delhi,  
Delhi-8, December 8, 1955.

R. P. SINGH.

1. Singh, R. P., *Curr. Sci.*, 1955, **24**, 208.
2. —, and Vishnu Shankar, *J. Ind. Chem. Soc.*, 1955, **32**, 557.
3. Gambhir, I. R. and Singh, R. P., *Proc. Ind. Acad. Sci.*, 1946, **23A**, 330.

#### ECHINORHYNCHOTAENIA LUCKNOW- ENSIS N. SP. (HYMENOLEPIDIDAE: CESTODA) FROM DARTER, ANHINGA MELANOGASTER PENNANT

A new cestode *E. lucknowensis* is described from darter bird, *Anhinga melanogaster*. The parasite measures 278 mm. in length and 4.5 mm. in maximum breadth. The scolex measures 0.4-0.43 mm. by 0.28-0.32 mm. The rostellum is 0.3-0.415 mm. in length and is armed throughout its length with numerous small spines, 0.011-0.012 mm. in length. The suckers are unarmed. Each proglottid has three testes: two posterior and one anterior and aporal, thus triangular in position. The cirrus pouch extends one-third across the proglottid. The cirrus is muscular and armed with small spines at the base. A large receptaculum seminis is present and the uterus is sac-like, extending beyond the longitudinal excretory ducts. Rest of the genital organs are typically hymenolepid. Certain variations in the position of the testes and genital pores are also recorded.

The genus possesses two species: *E. tritesticulata* Fuhrmann, 1909 (Africa)<sup>1,2</sup> and *E. nana* Maplestone and Southwell, 1922 (Australia).<sup>3</sup> The present form differs from both these species mainly in the position of the testes. This appears to be the first record of the genus *Echinorhynchotaenia* Fuhrmann, 1909, from India.

The full description of this new species is being published elsewhere.

My thanks are due to Dr. Kr. S. Singh for his guidance.

Dept. of Zoology,  
The University, Lucknow,  
December 1, 1955.

K. P. SINGH.

1. Fuhrmann, O., *Results of the Swedish Zoological Expedition to Egypt and the White Nile*, 1901, Part 3, 1909, 1.
2. Southwell, T. and Lake, F., *Ann. Trop. Med. and Parasit.*, 1930, **33** (2), 107.
3. Maplestone, P. A. and Southwell, T., *Ibid.*, 1922, **16** (2), 189.

#### OCCURRENCE OF TWO WOOD-BORING PHOLADS AT MADRAS

PREVIOUS workers<sup>2-5</sup> have recorded only *Martesia striata* in India. However, in a recent survey of wood-boring pholads of Madras Coast, *M. (M) fragilis* was collected from catamarans and fishing boats from the open sea, and has not been met with inside the harbour area where *M. striata* abounds. Identification



was confirmed by Dr. Ruth Turner of the Museum of Comparative Zoology, Harvard University, who is of the opinion that this is pelagic in habit even in the West.

In view of the importance of *M. fragilis* as a pest of catamarans and fishing boats, a brief preliminary account of this species is given here.

In this pholad as well as in *M. striata*, identification is rendered difficult because, (i) the callum is developed as the young grows into the adult, and (ii) the dorsal plates of the mesoplax are double in the young form and become fused in the adult. These facts brought to light by Turner<sup>6</sup> necessitated *Martesia* (*Diploplax*) *americana* and *M. (Diploplax) funisicola* as well as *M. (Diploplax) exquisita* and *M. (Diploplax) bahamensis* which were treated as distinct species by Bartsch and Rehder<sup>1</sup> being brought into *M. striata* and *M. fragilis*.

Owing to the great similarity between the two species (*M. striata* and *M. fragilis*) in these respects, distinction between the two can be made only on the basis of the dorsal plate of the mesoplax bearing concentric lines in *M. fragilis* and the dorsal plate being irregularly wrinkled in *M. striata*. Among other features of difference the following may be mentioned: The umbonal reflection is more pronounced in *M. fragilis* since it is twice the thickness of what is found in *M. striata*. The shells of *M. fragilis* are smaller and more delicate (ranging from 6-18 mm.) than the shells of *M. striata* (ranging from 6-36 mm.). It is possible therefore to distinguish shells beyond 18 mm. in length as those of *M. striata*.

Our grateful thanks are due to Prof. C. P. Gnanamuthu for his valuable guidance during this study.

University Zoology Lab., A. DANIEL.  
Chepauk, Madras, V. V. SRINIVASAN.  
November 17, 1955.

# OCCURRENCE OF A MERMETHID WORM PARASITE ON *HELOPELTIS* *THEIVORA* WATERHOUSE

In the course of investigation of tea-insect pests, we came across several specimens of *H. theivora* heavily infested with the mermethid parasitic worms. This is of considerable importance because so far no effective natural enemy of this insect pest has been reported. Mermethid infection of insects is not uncommon.<sup>1,2</sup> But such infestation of *Helopeltis* was not previously reported. It opens the possibility of biological control of the tea-bug in tea plantations.

*Helopeltis theivora* sporadically breaks out into a pest causing serious damage to tea plantations. The cause of sudden appearance and disappearance of the pest, however, remains a mystery.<sup>3,4</sup>

The specimens of *H. theivora* infested by the mermethid species were obtained from Kantalguri Tea Estates in the Jalpaiguri District of West Bengal, during the months of July and August 1946, which coincided with the rainy season. The hosts showed no external visible sign of infestation until the viscera of the insect was examined. In a collection of insects comprised of five males, six females and nine nymphs at the 3rd, 4th, 5th instars, numbering twenty in all, eight specimens comprised of two



FIG. 1. Photomicrograph of the mermethid worm around the viscera of *Helopeltis theivora*.

1. Bartsch, P. and Rehder, H. A., *Smith. Misc. Collections*, 1945 **104**, 1.
2. Beeson, C. F. C., *Indian Forester*, 1936, **62**, 1.
3. Erlanson, E. W., *Curr. Sci.*, 1936, **4**, 726.
4. Ganapathi, P. N. and Nagabushanam, R., *Ibid.*, 1953, **22**, 345.
5. Palekar, V. C. and Bal, D. V., *Proc. Ind. Sci. Cong.* (Abstract), 1955.
6. Turner, Ruth D., *Museum Comp. Zool. Johnsonia*, 1954, **3**, Nos. 33 and 34, 1-160.

males, three females and three nymphs at 3rd instars were found parasitized by the worm. In each insect a single juvenile worm was found. The largest worm was 7 cm. in length and 0.3 cm. in diameter, and the smallest measures 5 cm. in length. The worm was found in the hæmocœlic cavity of the abdomen entwining the general viscera of the insect (Fig. 1). The anterior end of the worm was found attached to a small conical growth on the midgut of the insect (Fig. 2). In normal anatomy of this

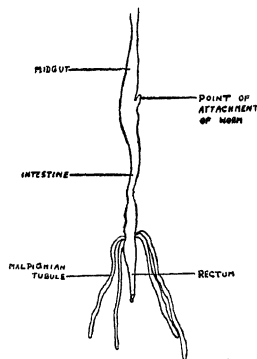


FIG. 2. Deformed gut of the parasitized *Helopeltis theivora*.

insect, such a cone formation is not found, and evidently this was a pathological growth as a result of mermethid infection. Other organs of the host also suffer degeneration. The salivary glands of the adult insect became reduced in size and were pale white in colour instead of brown. The midgut was very much reduced in size with narrowing down of its lumen, feeble development of circular and longitudinal mus-

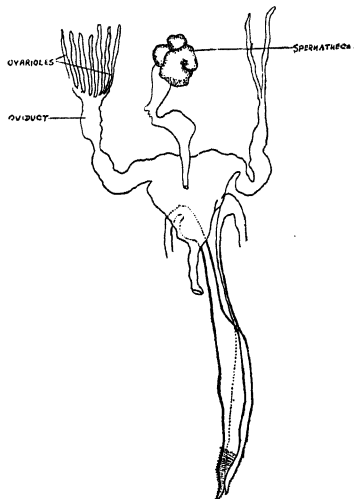


FIG. 3. Degeneration of ovarioles in the parasitized *Helopeltis theivora*.

cles and the absence of secretory granules in the epithelial cells. The intestine became short and straight, the intestinal coils being lost and fat bodies disappeared or disintegrated into granules.

Reproductive organs of both male and female insects showed remarkable degeneration, ovarioles were reduced in number and ceased to produce eggs. The egg chambers became indistinct. In one specimen the normal number of ovarioles which is seven, persisted on one side, while on the other side it was reduced to two (Fig. 3). However, the spermatheca and the accessory glands were not much affected. In males, the testes with ducts atrophied and disappeared. The ejaculatory duct, however, persisted as in normal. The external appearance of the parasitized insect was not much affected. Wings, mouth-parts and legs remained as in normal.

We have pleasure in thanking the Indian Tea Planters' Association, Jalpaiguri, for financing the scheme and giving us all facilities for field work.

DURGADAS MUKERJI.

SAMBHUNATH RAYCHOUDHURI.\*

Entomology Lab.,  
Zoology Dept.,  
Calcutta University,  
October 6, 1955.

1. Hyman, L. H., *The Invertebrates*, 1951, 3 (McGraw Hill, New York).
2. Iyengar, M. O. P., *Trans. East. Assn. Med.*, 7th Congress, India (Dec. 1927), 1929, 128.
3. Mukerji, D., *Presidential Address, Zoology and Entomology Section, Indian Science Congress, 1942*.
4. —, *Mosquito Research Report, Indian Tea Planters' Association, Jalpaiguri, 1943*.

\* Now at Presidency College, Calcutta.

### PHOTOPERIODIC BEHAVIOUR OF "THAILAND"—A PHILIPPINE VARIETY OF RICE

PHOTOPERIODIC studies has been carried out with rice of different countries of the world<sup>1-6</sup> with varied results. The present investigation aims at finding out the photoperiodic behaviour of a variety of rice, "Thailand", of Philippines procured from the Central Rice Research Institute, Cuttack. The grains, after a preliminary selection for uniformity, were soaked in water and, when visible germination was observed, were sown on December 21, 1953, in earthenware seed-bed pots containing well mixed soil and cowdung manure mixture in the proportion of 9:1 parts by volume. Seedlings 35 days old were transplanted on January 25, 1954, to bigger-sized (10" × 10") earthenware pots

TABLE I  
(Average figures of 24 plants)

		21-2-1954	2-3-1954	16-3-1954	Ear-bearing tillers
Number of tillers per plant	A	1.54	2.37	5.17	5.00
	B	3.25	3.54	5.87	5.77
	C	4.58	6.45	6.75	5.66
Number of green leaves per plant	A	6.87	10.58	16.73	
	B	12.25	14.87	20.04	
	C	16.45	26.79	25.08	
Height per plant in cm.	A	31.25	40.25	61.09	
	B	40.81	49.35	66.07	
	C	40.22	50.60	57.73	
Time from sowing to ear emergence in days		Main shoot	1st tiller	2nd tiller	
	A	96.30	99.15	100.50	
	B	96.52	98.56	99.54	
	C	101.54	104.28	106.04	

A—Short photoperiod to 40-day old seedlings; B—Short photoperiod to 55-day old seedlings; C—Controls.

at the rate of 8 seedlings per pot. After a week, the plants were thinned down to 4 per pot. Short photoperiods of 8-hour duration in a 24-hour cycle were given to 40-day-old seedlings for 40 days in one set and to 55-day-old seedlings for 40 days in another set. A third set was all along maintained under the normal day length as controls. The data pertaining to the formation of tillers, leaves and the height of the plant were collected at intervals and finally the number of ear-bearing tillers and the duration of the vegetative period from sowing to ear emergence, were recorded and are presented in Table I.

A study of Table I brings out the following salient points:

(i) Tillering has been greatly retarded under the influence of the short day, the effect being much more conspicuous when the treatment was given at the earlier age of 40 days. (ii) The formation of leaves has been adversely affected exactly as the tillers as a result of the short-day treatment. (iii) The height of the plant has been inhibited only in the case when the short photoperiods were given to 40-day-old seedlings. The inhibiting effect is operative as long as the short days are given. So, at the final stage when the short days have been discontinued, there has been an increase in height. In the set which received the short photoperiods at 55th day, there is no marked difference from the controls except at the final stage when the plants attain a much greater height than the controls. (iv) With regard to the effect of short days in the matter of time taken to ear emergence it is seen that short photoperiods for 40 days to 40-day and 55-day-old seedlings brought about a signi-

ficant earlier ear emergence in the main shoot, first and second tillers.

We are thankful to the Utkal University for a grant-in-aid from the Jnan Vijnan Parishad Fund, and to Sri. J. K. Das for assistance.

Dept. of Botany, B. SAMANTARAI.  
Ravenshaw College, G. MISRA.  
Cuttack-3, November 3, 1955.

1. Beachell, H. M., *J. Agric. Res.*, 1943, **66**, 325.
2. Chandraratna, M. F., *New Phytol.*, 1954, **53**, 397.
3. Ghosh, R. L. M. and Shastry, S. V. S., *Euphytica*, 1954, **3**, 221.
4. Misra, G., *Agron. J.*, 1955, **47**, 393.
5. —, *Proc. Nat. Inst. Sci., India*, 1956, **22** (In press).
6. Sircar, S. M., *Lotsya*, 1948, **1**, 121.

#### LIFE-HISTORY AND HOST RANGE OF *PRODECATOMA PONGAMIAE* MANI AND KURIAN (HYMENOPTERA—FAMILY EURYTOMIDAE)

THE Hymenopterous parasite *Prodecatoma pongamiae* was newly recorded and its taxonomic characters described by Mani and Chandy Kurian only recently.<sup>1</sup> However, details regarding the biology of the parasite and its host range yet remain to be investigated. Recently, at Dharwar while working out the seasonal life-history of "udid" (*Phaseolus mungo*) weevil pest—*Apion* sp., a considerable number of the grubs were found parasitised by the above parasite. The incidence of the parasite in nature during September and October 1955 ranged between 19.0 to 25.3 per cent. Since the details regarding the life-history of the parasite *P. pongamiae* with reference to any host insects have not been worked out previously, the information is summarised below.

Details of the life-history of the parasite *P. pongamiae* with reference to one host insect are given in Table I. The parasites were reared in the laboratory between 6-9-1955 to 30-9-1955. In all the rearings carried out at 78.5° F. mean temperature and 91.4% humidity, only a single adult parasite developed from a host grub. Further details regarding the different life-stages of the parasite are given in Table I.

TABLE I

Showing the life-history of *P. pongamiae* in relation to its host *Apion* sp.

S. No.	Pre-oviposition period in days	Post-embryonic developmental period in days	No. of adult parasites emerged from each host	Duration of life of adults in days
1	3	4	1	3
2	3	4	1	4
3	2	5	1	4
4	3	5	1	3
5	3	4	1	4
6	2	5	1	3
7	2	5	1	4
Average	2.5	4.5	1.0	3.5

In all the cases, the host grubs of 3-4 days old only were selected by the parasite for the purpose of oviposition. The prepupal stage of the host grub escaped parasitisation even under artificial inoculations. In nature parasites exhibited sharp instinctive powers for locating the host grubs developing within the seed pods. The average life-history of the parasite in relation to the host *Apion* sp. worked out to be 7 days.

Entomological Lab., H. L. KULKARNY.  
College of Agriculture, N. L. HALLEPPANAVAR.  
Dharwar, October 27, 1955.

1. Mani, M. S. and Chandy Kurian, *Ind. J. Ent.*, 1953, 15, 1.

#### FURTHER STUDIES ON *SCILLA HOHENACKERI* FISCH. & MEY.

A SHORT note dealing with the somatic chromosomes of *Scilla hohackeri* was published previously in this journal.<sup>1</sup> Further study with the application of improved technique has not only confirmed the previous observations but revealed certain additional features in the morphology of chromosomes of this species. The technique employed during the present investigation involves a pre-treatment of root-tips with  $\alpha$ -bromo-naphthalene for 2 hours followed by a fixation in a mixture of Benda and

0.001 mol. oxyquinoline at 8-10° C. Feulgen squash preparations were made with such root-tip material.

As will be seen from Fig. 1, the diploid chromosome complement of *Scilla hohackeri*

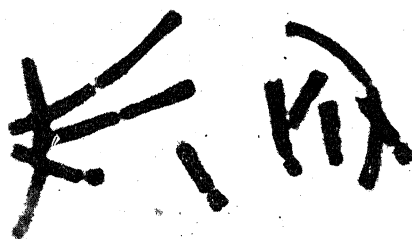


FIG. 1. Photomicrograph of the somatic metaphase of *Scilla hohackeri* showing 10 chromosomes, out of which 4 medium-sized chromosomes are characterised by heterochromatic segments,  $\times$  about 1,500.

( $2n=10$ ) consists of: (i) two pairs of long chromosomes, one with median and the other with submedian primary constrictions; (ii) two pairs of medium-sized chromosomes of variable lengths, each with a subterminal primary constriction and a secondary constriction in the short arm very close to the primary one; (iii) one short pair of chromosomes with a subterminal primary constriction and two secondary constrictions in the long distal arms. The proximal arms of this pair are knob-like and are devoid of secondary constrictions unlike the previous pairs.

One of the outstanding features of the karyotype is the presence of heterochromatic segments at the distal ends of the medium-sized chromosomes. No other chromosome type showed the same. Very careful search has revealed no such segments in the intercalary parts of any of the chromosomes in the complement (except perhaps at the primary insertion regions, where it is presumed to be always present). Even if present, they are certainly not visible under microscope. Hence, the terminal location of heterochromatin in the chromosomes of *Scilla hohackeri* appears to have some adaptive significance.

Furthermore, a study of about 100 metaphases from 9 bulbs showed that the number of medium-sized chromosomes carrying heterochromatic segments vary consistently from plant to plant in *Scilla hohackeri*. Some plants are characterised by chromosomes with no heterochromatic segments and others showed 1-4 such chromosomes. Whenever they are 4 in number, one pair has very short and the

other fairly long heterochromatic segments. Such plants with 4 segments were found to be more vigorous in growth than the rest. It is therefore inferred that the physiological effect of variation with regard to the extent of heterochromatic material in different individuals of *Scilla hohenackeri* may be similar to that of supernumerary chromosomes within a species population.

Dept. of Botany, Y. SUNDAR RAO.  
University of Saugar,  
Sagar, M.P.,  
November 8, 1955.

1. Sundar Rao, Y., *Curr. Sci.*, 1954, 23, 94.

#### TECHNIQUE FOR ARTIFICIAL INOCULATION OF COTTON PLANTS WITH *MACROPHOMINA PHASEOLI*

Root rot of cotton incited by *Macrophomina phaseoli* (Maubl.) Ashby is a major disease of cotton in Bombay State especially in the *Goradu* soils of Gujarat. Uptil now for lack of proper inoculation technique for obtaining infection under controlled conditions in the laboratory, all the studies on cotton root rot by different investigators have been based on naturally infected plants in the field. In the present study, the disease was artificially produced in the laboratory under pot culture tests. The fungus which could easily be isolated on potato dextrose agar from diseased specimens grew very rapidly at 30° C. producing greyish cottony-white mycelium. The following technique was successfully adopted in producing 100% infection.

10-45-days old cotton seedlings raised in sterilised soil in 6" pots were used for inoculation purposes. The fungus was grown on corn-meal sand medium in large sterilized kilner jars. After 24, 48 and 72 hours incubation at 30° C., the mycelial mat was carefully scooped with the help of a sterilized spatula taking care that no mycelial strands were damaged. This inoculum was placed in close juxtaposition with the roots by lifting little soil near the root. The fungus was allowed to remain undisturbed *in situ* by covering it with a light soil layer. The inoculated pots were incubated at 28° C. and several uninoculated plants served as controls. The watering of pots was done twice a day taking care that excess of watering was avoided. It was noticed that plants inoculated with 48-hour old culture showed maximum death rate. This is probably because the evanescent mycelium breaks down forming sclerotial bodies as it grows older.

This finding is in conformity with that reported by Thirumalachar<sup>1</sup> who obtained similar results with charcoal rot of potato. The inoculated plants suddenly droop down on the 3rd or 4th day after inoculation (Fig. 1). Such

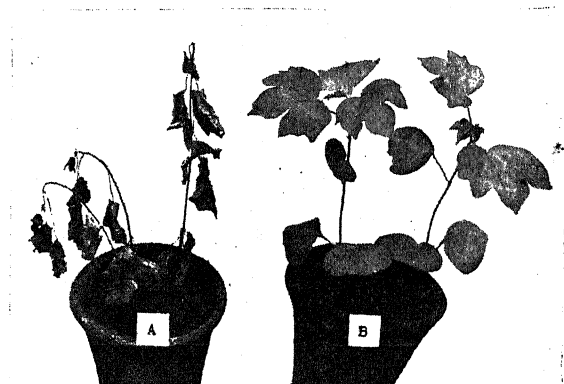


FIG. 1. A—Diseased ; B—Control.

plants when uprooted showed completely damaged condition of lateral root system. The bark of such plants could easily be peeled off leaving brown discolouration of the exposed area which was densely covered with sclerotial bodies. The diseased plants on re-isolation yielded the original fungus which on re-inoculation proved equally pathogenic. Besides cotton, the fungus was found equally pathogenic to *Dolichos lablab* L., on which was found characteristic persistent fumaceous mycelium with irregularly formed sclerotial bodies.

Further work is in progress.

L. MONIZ.

M. J. THIRUMALACHAR.

M. K. PATEL.

Plant Pathological Lab.,  
Agric. College, Poona,  
December 2, 1955.

1. Thirumalachar, M. J., *Phytopathology*, 1955, 45, 91.

#### STUDIES ON *SORGHUM NITIDUM* PERS.

The chromosome numbers of *Sorghum nitidum* collected at Rangaswami Hills and at other places between elevations of 3,500-5,000' were found to be  $2n = 20$ .<sup>1</sup> Subsequently, collections made from other places gave plants with  $2n = 10$  chromosomes. The habitats and plant associations were similar for these two chromosome forms. Morphologically also they are similar. While the 20-chromosomed plant grows to a height of 10' the other attains only 4-5'. Since this is the first record of the occurrence

of the 10-chromosomed form of the species a brief account of its behaviour is reported below.

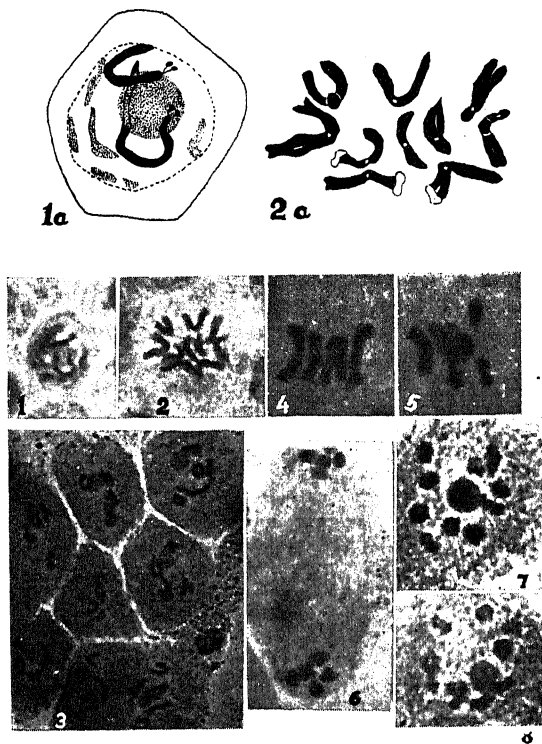
Somatic chromosomes as determined in root tip preparations are large, and more or less equal in length. There are four median, four submedian and two subterminal constricted chromosomes. The nuclear chromosomes are two, satellited and subterminally constricted (Figs. 1, 1 a, 2, 2 a). The meiosis as observed

The meiosis of the 20-chromosomed form shows in all P.M.C.s only a single bivalent found attached to the nucleolus except in the material from Wynaad (Mavinahalla, Ambalavayal) in which two cases with a doubtful quadrivalent were noted. The rest of the meiosis is normal (Figs. 7 and 8).

Garber<sup>2</sup> considers *S. nitidum* to be an allo-tetraploid species of the series Para-sorghum. Krishnaswamy and Raman<sup>1</sup> confirmed the number found by Garber. Based on the evidence obtained by the analysis of chromosome pairing in the interspecific hybrid *S. leiocladum* × *S. nitidum*, Garber<sup>2</sup> derives the genomic constitution of nitidum as  $L^b L^b L^r L^r$  of the  $L^b$  genome being closely related to  $L^a$  of *S. leiocladum*. The karyotype of the 10-chromosomed *S. nitidum* is similar to that described by Garber for the 20-chromosomed plant. The nucleolar chromosomes, however, have remained only two in the 10-form. The question then arises how far the 10-chromosomed form is a diploid of the 20-form. If the latter were due to duplication, there should have been four nucleolar chromosomes but only two have been observed so far. Such a condition could have arisen by the loss of the nucleolus organising segment in one pair, but unless there has been complete change of homology, these two should have given occasional pairing with the nucleolar chromosomes and trivalents and quadrivalents could have been expected. The 20-chromosomed plant, however, exhibits only bivalents. The affinity between the diploid and tetraploid forms could only be determined by actual hybridisation. Garber<sup>3</sup> has stated that only two diploid species are known in the parasorghums. The present plant would form the third species.

Our thanks are due to Sri. D. Krishnaswami for help in taking the microphotographs and Sri. N. R. Ramamurthy in the collection of nitidum plants.

Cytogenetics Lab., N. KRISHNASWAMY.  
Agric. Col. & Res. Inst., V. S. RAMAN.  
Lawley Road, P.O., P. CHANDRASEKHARAN.  
Coimbatore,  
November 7, 1955.



FIGS. 1, 2, 4, 5, 7 and 8 = × 1,400; FIGS. 1 a and 2 a = × 3,110; FIG. 3 = × 585; FIG. 6 = × 1,120.

FIGS. 1 to 6. *S. nitidum* ( $2n=10$ )—1. Somatic prophase showing satellited nucleolar chromosomes; 1 a. Camera lucida drawing of the microphotograph; 2. Somatic metaphase plate. 2 a. Camera lucida drawing of the same; 3. Diakinesis showing one bivalent attached to the nucleolus; 4. metaphase ( $5_{11}$ ); 5. Anaphase; 6. telophase with 5-5 distribution; FIGS. 7 and 8. Diakinesis of 20-chromosomed form with one nucleolar bivalent in Fig. 7 and a probable two in Fig. 8.

in acetocarmine smears is normal giving five bivalents. The nucleolar chromosomes form a bivalent. The metaphase is compact with a normal bipolar spindle. The telophasic distribution is regular giving 5-5 at poles (Figs. 3 to 6).

1. Krishnaswamy, N. and Raman, V. S., *Madras Agric. J.*, 1953, **40**, 115.

2. Garber, E. D., *Univ. Calif. Pub. (Bot.)*, 1953, **23**, 283.

3. —, *Bot. Gaz.*, 1954, **115**, 336.

---



---

## REVIEWS

---



---

**Scattering and Diffraction of Radio Waves.**

By J. R. Mentzer. (Pergamon Press), 1955.  
Pp. viii + 134. Price 30 sh.

This is a book in the series of monographs on *Electronics and Waves*, edited by Mr. D. W. Fry of Harwell.

The book deals with the mathematical methods of treating the problem of scattering of electromagnetic waves by bodies of different shapes with a view to their application to the calculation of echo cross-sections of radar targets. Rigorous calculations are possible only in a few simple cases such as a conducting or dielectric sphere, a long cylinder, an infinite conducting cone, a thin conducting plate, etc., the essential condition being that the wave equation can be "separated" in a co-ordinate system which is suited to the shape of the scattering object. In addition to the classical method, an alternative vector variational method due to Schwinger which can be used to obtain approximate solutions of practical diffraction problems is explained and applied to the important case of scattering by thin wires.

The last chapter deals with the techniques in use for the measurement of radar cross-sections of complicated scatterers like aircraft, using scale models on a convenient smaller scale and corresponding shorter wavelengths.

The book has many neat diagrams and is well printed. The exposition is clear and the book will prove very useful to advanced students and instructors in radio and radar physics. The price (30 sh.) is rather high for a book of 134 pages.

K. R. RAMANATHAN.

**High Vacuum Technique.** 3rd Edition. By J. Yarwood. (Chapman & Hall), 1955. Pp. viii + 208. Price 25 sh.

Modern high vacuum technique started with the pioneering work of Gaede in 1910 and since then, it has made several rapid strides, in answer to the need for very high order of vacua to be maintained in large vacuum systems, both in the laboratory and industry. The appearance of a third edition of the book under review, within the last twelve years, indicates both the popularity of this book and the growing trends in the subject.

Compared to the previous editions, substantial additions have been made. Diffusion pump theory is analysed in greater detail and a number of recent innovations in vacuum gadgets like valves and other control devices are discussed. An important feature is the comparative data on the availability and performance of various types of rotary and diffusion pumps, oils and measuring devices of different manufactures. This information, together with the last chapter on the properties of some of the important materials used in vacuum technique, will be very useful for constructing a vacuum system.

The subject-matter is practically up to date except for some of the attempts, since 1953, at producing high vacua, without any working fluid like oil or mercury. But this is also indicated in principle, in the discussion of the pumping action of the ionisation gauge.

This, however, is a very minor criticism of an excellent book which will be instructing and informative for physicists and engineers.

K. S. CHANDRASEKARAN.

**Antimetabolites and Cancer.** Edited by C. P. Rhoads. (American Association for the Advancement of Science Publication), 1955. Pp. 312. Price \$ 5.75.

"Once cancer, always cancer" seemed to be the dictum, as voiced by C. P. Rhoads, of a school of cancerologists who believe in the somatic mutation as the origin of cancer. Since this hypothesis implies that mutations cannot be reversed or prevented by environmental or directive manner, this view-point is tinged with fatalistic implications. The field, however, is not so gloomy as it appears. For example, there is another school of workers who would like to consider cancer "as resulting from aberrations in morphogenesis" (Davis). "Since the morphogenetic changes do involve directive environmental influence, the morphogenetic aberration hypothesis has a much more cheerful implication, in that, if only we learn to modify the environment of a cell appropriately, we may be able to prevent or even reverse the neoplastic developments."

Whatever be the theories of the origin of cancer, the job of a person seeking to cure it becomes one of devising means for the selective restraint of growth or the destruction of

neoplastic cell, no matter where in the body it may be. Till recently, the only hope lay either in radical surgery or in radiation therapy, both of which have cured many early cancers. Recently a new and a promising tool, namely, antimetabolites, has been added in the armoury against cancer.

Interference with normal growth-pattern by inducing a chemical competition between a synthetic compound and an essential metabolite has been known for quite some time; but its potential implications were recognised only after its applications in bacteriostasis have been amply rewarded. The antimetabolite principle was first tried in chemotherapy of cancer as late as 1948. During the last six to seven years the field has grown so enormously that it is difficult to keep track of all the developments even for those who are actively on the lookout for information. The volume under review which records the proceedings of a symposium on Antimetabolites and Cancer, held under the auspices of the American Association for the Advancement of Science in 1953, is therefore a welcome one, even though its scope is limited to contributions from American workers only.

As the title of the book would suggest, the major portion deals with chemotherapy of cancer. There are, however, sections dealing with the applications of the antimetabolite principles in the studies of plant material, and of the protozoan *tetrahymena* as also in the normal mammalian fetal development.

Among the antimetabolites extensively investigated, aminopterin and A-methopterin feature prominently as the folic acid antagonists, and 2:6 diaminopurine, 6-mercaptopurine, 8-azaguanine and other analogues of purines and pyrimidines as the antinucleic acid metabolites. One of the necessary evils of antimetabolite therapy is the acquired drug resistance. This has partially been discussed although the reviewer would have liked to see this extensively discussed, since this forms the basis of the usefulness or otherwise of the antimetabolite principle. On the whole, the book is a very thought-provoking one and will be useful for all biological workers and particularly for those interested in the problem of cancer.

M. B. SAHASRABUDHE.

**Rain-Making; Its Present Position and Future Possibilities.** By A. K. Roy. (Published by CSIR, New Delhi), 1955. Pp. iii + 28.

Much has been written on this subject in the last few years in the scientific and the lay press, and the informative article by A. K.

Roy who is in charge of the Experimental Rain Cloud Physics Research Unit of the Council of Scientific and Industrial Research is very welcome. The article starts with the mode of rain formation in clouds, and discusses the possibilities of rain-making in supercooled and 'warm' clouds. This is followed by a critical assessment of the results of rain-making experiments conducted so far, and the article concludes by indicating the limitations of known techniques of rain-making. The monograph is well illustrated and includes a few photographs of successful rain-making, and contains also a select bibliography.

**Methods in Enzymology, Vol. I.** Edited by S. P. Colowick and N. O. Kaplan. (Academic Press), 1955. Pp. 835. Price \$18.00.

The present volume is the first of a series of four which the publishers propose to bring forth. The objective, as stated in the preface, is to present "for the first time in the English language, a comprehensive compilation of the methods used in the study of enzymes. In certain respects, this work should serve as a companion piece for Sumner and Myerback's "The Enzymes", in which methodology has been emphasised".

The book consists of four sections: general preparative procedures, enzymes of carbohydrate metabolism, enzymes of lipid metabolism and enzymes of citric acid cycle. As the name of the book indicates, much stress is laid on the methodology of enzymes, each enzyme being dealt with under the heads assay methods, purification and properties. Section I is devoted to the general preparative procedures comprising tissue slice technique, tissue homogenates, fractionation of cellular components, methods of extraction and fractionation, and preparation of buffers. Section II deals with the enzymes of carbohydrate metabolism, preparation, purification, assay methods and properties of enzymes relating to the hydrolysis and synthesis of polysaccharides, metabolism of hexoses, pentoses, three-carbon compounds, two-carbon compounds and formate reactions. Section III relates to the enzymes of fatty acid oxidation and acyl transfer and activation; lipases and esterases and phospholipid and steroid enzymes. The enzymes of citric acid cycle have been dealt with in Section IV.

Leading scientists all over the world who are specialists in the particular field have contributed various articles in this book. Although it is not an exhaustive account of all aspects



of enzyme chemistry, it serves as a very useful guide and as laboratory manual not only for the enzymologist but also for those working in the fields of biological and medical sciences who have to evaluate the known enzymes in relation to other metabolic processes, in which enzymes play an important role in cellular function.

The book is pleasingly free from misprints. The format is good, and the Academic Press is to be congratulated upon its share in this fine work. The editing by S. P. Colowick and N. O. Kaplan also calls for praise.

K. V. GIRI.

**Origins of Resistance to Toxic Agents.** Edited by M. G. Sevag, Roger D. Reid and O. E. Reynolds. (Academic Press), 1955. Pp. xv + 471. Price \$12.00.

The book under review records in its entirety the Symposium organised at Washington D.C. in March 1954 to discuss the "many facets" of the origins of drug resistance and related problems.

The editors took a broad view of the subject and posed basic questions (Appendix I) like the possibility of acquisition of drug resistance being associated with the emergence into prominence of pre-existing drug insensitive alternate metabolic pathways; acquisition of one or more detoxication mechanisms by the resistant cells; control and development of resistance; origin of drug resistant individuals, and many such others. The result has been to attract papers on such diverse topics as mechanisms of the origin of resistance to drugs in bacteria and protozoa, alcoholism and drug addiction, and mechanisms of carcinogenesis. Alterations and/or loss in enzyme proteins appear to be a feature common to all the phenomena discussed and hence the justification of bringing them all into a common focus. The inescapable conclusion that emerges from all these discussions, which incidentally are of a very fundamental and thought-provoking nature, is the meagreness of our knowledge concerning the potentialities of the living cell to devise means for counteracting the toxic action of a foreign body. The core of the problem has yet to be discovered.

Both the presentation of papers and discussions have been done in an admirable way. The genetotropic approach to alcoholism by Roger Williams is especially commendable. He has based his approach on two facts: (i) proneness to alcoholism is a condition from which, in human experience, victims never recover,

and (ii) every individual person (alcoholic or not) is born with distinctive metabolic machinery that is genetically determined. Sevag's plea for assigning to proteins an equally important role in genetic variation as hitherto given to DNA and the lucid exposition of metabolic blocks by Mitchell, are some of the other important contributions. Enzymologists will find something of interest in every paper that has been presented in the Symposium.

It is satisfying to find that although workers in very diverse disciplines have contributed to a symposium, yet there is a common thread and unity of approach. Here is a model for symposia in our country.

D. L. SHRIVASTAVA.

**Annual Review of Biochemistry**, Vol. 24. (Published by Annual Reviews Inc., Stanford, California), 1955. Pp. xvi + 805. Price \$7.00.

This year's volume of the *Annual Review of Biochemistry* appears bulkier than some of the previous volumes in this series and has a preface article on Herman Augustus Spoeher (1885-1954) by Smith and French. This is followed by the usual review articles on biological oxidations by Green and Beinert, non-oxidative non-proteolytic enzymes by Axelrod, proteolytic enzymes by Schwert, chemistry of carbohydrates by Jones, chemistry of the phosphatides by Baer, metabolism of the complex lipides by Zilversmit, chemistry of proteins, peptides and amino acids by Ogston, carbohydrate metabolism by Horecker and Mehler, metabolism of amino acids and proteins by Ehrensward, water-soluble vitamins (in three parts) by Briggs, Daft, Fried, Lardy and Johnson, fat-soluble vitamins by Boyer, lipid metabolism by Lynen and nutrition by Brock.

There are, besides, the following six special review articles on subjects of biochemical importance: (i) Nucleic acids by Brown and Todd, (ii) Carotenoids by Goodwin, (iii) Biochemistry of the steroid hormones by Roberts and Szego, (iv) Biochemistry of antibiotics, by Binkley, (v) Clinical applications of biochemistry by Bodansky, and (vi) Biochemistry of cancer, by Haddow. As may be seen from the names of the authors given above, these articles have been written by specialists who have worked extensively in their respective fields and who can therefore appreciate the merits and point out the defects among the very large number of research papers published during the year under review. Particular mention may, however, be made of the article on the

chemistry of the phosphatides, in which Dr. Baer has reviewed the more significant accomplishments such as "the isolation from baker's yeast of the first natural lecithin containing two unsaturated fatty acids and of thirteen individual lipopeptides from blood serum". Ogston in his review of the chemistry of proteins, peptides and amino acids has departed from the beaten track, by classifying the list of references under broad subject headings of his own, and by writing a short essay in which direct reference is made only to a small number of research papers. Brown and Todd have given an excellent account of nucleic acids as also Haddow on the biochemistry of cancer, the latter dealing extensively with the conception of carcinogenesis through loss of regulatory proteins, enzymes or antigens. Goodwin's article on carotenoids is very comprehensive and so are the two articles on the biochemistry of steroid hormones and of antibiotics. Oscar Bodansky has in his own inimitable fashion, dealt extensively on what he calls 'diagnostic biochemistry' and on the biochemical mechanisms in different diseases. The only article which appears to be slightly out of step is the one written by Dr. Brock on nutrition. For, apart from some vague generalities, he appears to have missed, in dealing with the 'Bifidus factor' of milk in p. 531, the latest developments so clearly mentioned in p. 453 under water-soluble vitamins. However, taking the volume as a whole, the editors have done remarkably well in covering a very wide field in the course of twenty articles.

The get-up of the volume is true to tradition, and considering the size, the volume is singularly free from serious errors or omissions. In the opinion of the reviewer, this annual number with such an excellent and varied fare, should prove as popular as ever among biochemists and others interested in the advancement of biochemical study and research.

P. S. SARMA.

#### Perspectives and Horizons in Microbiology.

Edited by Selman A. Waksman. (Rutgers University Press), 1955. Pp. x + 220. Price \$ 3.5.

The volume is a collection of papers presented at the symposium arranged in connection with the dedication of the Institute of Microbiology, Rutgers University, and very appropriately covers varied aspects of the science devoted to the study of the microscopic forms of life and their relation to mankind.

As the title rightly indicates, the authors of the different essays—all well known in their respective field of research—besides reviewing present knowledge, pose many unsolved problems, thus making the whole book very interesting and stimulating to read.

The essays are arranged under three main headings: The Microbe as a Living System; Metabolism of Micro-organism and Micro-organism and Higher Form of Life. Starting with C. B. Van Niels' essay on 'The Microbe as a Whole', where the author advocates studies directed towards understanding the fundamental aspects of life, the essays which follow have generally made the point that researches on varied aspects of microbiology have contributed a great deal to understanding the dynamic aspects of biochemistry and the general fields of ecology, taxonomy, evolution. Except for the essay on 'Metapoeitic Integration' by André Lwoff, which by the nature of the subject is highly specialized, the other essays are all lucidly written without too much of technical jargon and can be profitably read by non-specialist and specialist alike.

An appendix contains three addresses delivered at the dedication ceremony, and includes one by Waksman on the scientific method, the education of a scientist, and the function of the Institute, and an interesting historical survey 'From Dutch Settlements to the Rutgers University of Microbiology' by Prof. Kluyver.

Organisation of such symposia at the opening of research institutions is a practice well worth emulating in this country.

V. S. GOVINDARAJAN.

**Abstract Bibliography of Cotton Breeding and Genetics (1900-1950).** By R. L. Knight. 1954. Pp. 256. Price 21 sh.

This book is published by the Commonwealth Bureau of Plant Breeding and Genetics, Cambridge, as Technical Communication No. 17. The author is well qualified to compile a work of this kind, as he has done much work on both cotton breeding and genetics in the Sudan. The book contains 1,191 citations to the literature, and there are three short Appendices. The first of these summarises the present state of our knowledge regarding the genomes of the genus *Gossypium*; the second contains a complete list of all the genes so far identified in the genus; the third summarises what is known of linkage relationships in both Old and New World cottons.

All important work is adequately, sometimes lengthily, summarised and there are few

omissions. The list of genes in *Appendix II* omits the three genes discovered in *G. armourianum* by the reviewer. A lumping together of all the genes known in the genus is a disputable procedure. There is a good index. As a work of reference, the present volume is indispensable to all cotton workers. Those working on other crops will find stimulation and valuable information in its pages. S. C. HARLAND.

#### Introduction to Theoretical Organic Chemistry.

By P. H. Hermans. Edited and Revised by R. E. Reeves. (Elseviers), 1954. Pp. xii + 507. Price 38 sh. 6d.

The expressed purpose of this book is to present an elementary and general picture of the advances in theoretical organic chemistry that have been made in the last twenty-five years. The author has not attempted to give a detailed treatment of the subject but rather to give a broad survey of the entire field of physical organic chemistry. The topics discussed are various and include quantum mechanics, structure theory, stereochemistry, spectroscopy, equilibria and reaction kinetics and mechanism of ionic and free radical reactions. The inclusion of such a large number of subjects for discussion in a book of this size has resulted in a somewhat superficial coverage of some sections.

The author is at his best in his discussions of the physical aspects of organic chemistry. The chapters on stereochemistry, resonance, refraction, polarisation and magnetic properties of molecules are written particularly well. The later chapters dealing with mechanisms of organic reactions are written in a conventional but uncritical manner. Well-established and classic studies are often placed alongside with casual suggestions of some authors, and the reader has no way of distinguishing between them. Furthermore, some errors of fact have crept in which will no doubt be corrected in future editions. In the section on applications of resonance concept, tautomeric forms of pyrazole are wrongly described as resonance structures. Again on p. 327, lithium hydride (instead of lithium aluminium hydride) is referred to as a reducing agent for ketones. The role of steric factors in organic reactions has not received the attention it deserves.

Despite these shortcomings, the book will be found useful by students wishing to keep abreast of recent developments in the field of theoretical organic chemistry, particularly if supplemented by a course of lectures.

S. SWAMINATHAN.

#### Books Received

*Numerical Analysis.* By Zdenek Kopal. (Chapman & Hall), 1955. Pp. xiv + 556. Price 63 sh.

*Law and the Engineer.* By Christopher F. Mayson. (Chapman & Hall), 1955. Pp. xx + 470. Price 63 sh.

*Ostodes of Whales and Dolphins from the Discovery Collections—Discovery Reports.* By S. Markowski. (Cambridge University Press), 1955. Pp. 377-95. Price 12 sh. 6d.

*Vacuum Valves in Pulse Technique.* By P. A. Neeteson. (Philips Technical Library), 1955. Pp. viii + 170. Price Rs. 12-8-0.

*Experimental Design and Its Statistical Basis.* By D. J. Finney. (Cambridge University Press), 1955. Pp. xi + 168. Price 30 sh.

*Flood Estimation and Control.* Third Edition. Revised. By B. D. Richards. (Chapman & Hall), 1955. Pp. xiii + 187. Price 35 sh.

*Principles and Problems in Energetics.* By J. N. Bronsted. (Translated from Danish by R. P. Bell.) (Interscience Publishers, Inc., New York), 1955. Pp. vii + 119. Price \$ 3.50.

*Mysidacea—Discovery Reports, Vol. XXVIII.* By S. Tattersall. (Cambridge University Press), 1955. Pp. 1-190. Price 65 sh.

*Biology of Poliomyelitis—Annals of the New York Academy of Sciences, Vol. 61, Art. 4.* Pp. 737-1064. Price \$ 5.00.

*Psychotherapy and Counselling—Annals of the New York Academy of Sciences, Vol. 63, Art. 3, 1955.* Pp. 319-432. Price \$ 3.50.

*The Geometry of Geodesics—Mathematics Monograph, Vol. VI.* By Herbert Brusemann. (Academic Press), 1955. Pp. vii + 422. Price \$ 9.00.

*Ancient India—Special Jubilee Number of Archaeological Survey of India, 1902-52, No. 9.* (The Director-General of Archaeology of India, New Delhi), 1953. Pp. 1-233. Price Rs. 17.

*Advances in Virus Research, Vol. III.* By Kenneth M. Smith and Max A. Lauffer. (Academic Press), 1955. Pp. ix + 338. Price \$ 18.00.

*Synthetic Ion-Exchangers—Recent Developments in Theory and Application.* By G. F. Osborn. (Chapman & Hall), 1955. Pp. ix + 419. Price 30 sh.

*Steels for the User.* Third Edition. By R. T. Rolfe. (Chapman & Hall), 1955. Pp. xvi + 399. Price 45 sh.

---

## SCIENCE NOTES AND NEWS

---

### Southern Languages Book Trust

The Southern Languages Book Trust is planning to compile a list of all publishers, book-sellers, printers, authors, artists and translators in South India and also compile a list of all organisations interested in these fields. The Book Trust, therefore, invites all those concerned to write to the General Manager, Southern Languages Book Trust, 3, Wheat Croft Road, Nungambakkam, Madras-31, for further particulars.

### Scintillation Counter for Human Subjects

The Los Alamos Scientific Laboratory has built a scintillation detector large enough to accommodate a human body and to measure its accumulated amount of radioactivity. The scintillation detector is a large cylindrical tank, 6 feet long and 28 inches in diameter. Through it runs a cavity large enough to contain the human subject to be measured. The walls of the tank contain a liquid which gives off minute flashes of light when gamma rays from the person pass through it. This light is detected and amplified by 108 photomultiplier tubes installed in the outer wall of the tank. Electronic instruments record the number of gamma rays registered. The entire tank is surrounded by a ten-ton lead shield to reduce interference by external radioactivities.

### Peaceful Uses of Atomic Energy : India and the United Kingdom

Discussions between the United Kingdom Atomic Energy Authority and the Indian Department of Atomic Energy have led to the conclusion of an agreement which ensures that there shall be close co-operation and mutual assistance between the Authority and the Department in the promotion and development of the peaceful uses of atomic energy. The agreement provides for the Authority and the Department to arrange for members of their staffs to consult and work together on mutually agreed topics. In furtherance of this agreement, the United Kingdom Atomic Energy Authority will provide the Indian Department of Atomic Energy with enriched uranium fuel elements for a 'swimming pool' reactor now under construction at Bombay. The agreement also includes arrangements for the Authority to assist in the design and construction of a high-flux research reactor which may be built at a later date.

### Study of Tropical Vegetation

The UNESCO South Asia Science Co-operation Office in New Delhi is organizing a symposium on the 'Study of Tropical Vegetation' in Kandy (Ceylon) from 19-21 March 1956. The twenty participants have been invited from Europe, U.S.A., Australia and six countries from South and South-East Asia.

The principal object of the symposium is to attempt to reach international accord on the question of nomenclature and classification of types of tropical vegetation. It is planned to collate information on what has been done on mapping of forests, grasslands and other types of tropical vegetation and to discuss techniques which are being used and which are recommended to be used for the study of these types of vegetation. Since taxonomic work is an essential prerequisite for detailed studies of plant communities, a discussion on this topic for various territories will be held.

Immediately following this programme, the preparatory meeting of specialists in Humid Tropics Research will also be held in Kandy.

### Geological, Mining and Metallurgical Society of India

At the Thirty-First Annual General Meeting of the Society held recently, the following office-bearers for 1955-56 were elected :

*President* : Dr. C. S. Pichamuthu, Bangalore;  
*Vice-Presidents* : Mr. Jayantilal Ojha, Calcutta, and Mr. W. B. Metre, Digboi; *Joint-Secretaries* : Prof. N. N. Chatterjee, Calcutta, and Prof. N. L. Sharma, Dhanbad.

### Tata Medal Award For Zoology

The Zoological Society of India has awarded the Sir Dorab Tata Gold Medal to Dr. M. L. Roonwal, Forest Entomologist, at the Forest Research Institute, Dehra Dun, for his significant contributions to Zoology during 1952-54.

Dr. M. L. Roonwal has published a good many papers dealing with locust and other acrididae, forest entomology in general, termites, and teredinid boring bivalves in relation to forestry. His contributions on the desert locust are valuable both from the scientific and economic aspects, and lead to a better understanding of phase-transformation and population dynamics of the desert locust. He has also materially contributed towards the understanding of the problem of intraspecific variability.

### Indian Society for the History of Science

The formation of an Indian Society for the History of Science is being sponsored by a number of prominent scientists and historians in the country. The objects of the Society will be to promote the study of the history of science in India by arranging lectures, discussions and symposia on different aspects of history of science; eliciting support of various national institutions and universities to sponsor research on different aspects of the history of science and technology in India; disseminating the results of research through meetings and discussions, and publication of relevant material in suitable journals; and drawing the attention of the universities to the importance of teaching the history of science.

Scientists and historians in India are requested to become members of this Society and lend their active support to it. Further information can be had from Dr. A. Rahman, Central Laboratories, Hyderabad (Dn.).

### Chrome Tanning Industry and Tanning Processes

A symposium on chrome tanning industry and tanning processes will be held during the 3rd week of March 1956, in Calcutta, under the auspices of the Leather Technologists' Association (India). The object of the symposium is to foster exchange of ideas and thoughts between the leather technologists, tanners, research workers and people of the leather trade from all over India. The exact date and programme will be notified later. Further details can be had from: The Editor, *Journal of the Leather Technologists' Association (India)*, Bengal Tanning Institute, Canal South Road, Calcutta-15.

### Nuclear Science and Engineering

The American Nuclear Society is sponsoring the publication of a Journal with the above title, devoted to the presentation of theoretical and experimental papers relating to such subjects as nuclear reactor design, construction, operation; interaction of nuclear radiations and matter, basic phenomena in performance of nuclear fuels; production, uses and disposal of radioactive materials; chemical processing of nuclear fuels; basic and applied neutron physics;

heat transfer problems peculiar to nuclear reactors; technology of reactor materials; radiological safety, health physics, nuclear radiation shielding; nuclear instruments research and development; reactor and fission physics; systems for remote handling of radioactive materials; nuclear reactor stability and control; controlled release energy from nuclear fusion.

It is planned to publish one volume per year. Volume 1, Number 1, is scheduled for release in February 1956. Subscriptions for Volume 1, priced at \$10.00, should be sent to the publishers, Academic Press Inc., 125 East, 23rd Street, New York 10, New York.

### Strengthening Thorium

H. R. Ogden, R. M. Goldhoff, and R. J. Jaffee of the Battelle Institute, Columbus, Ohio, report that thorium can be significantly strengthened for use in nuclear reactors by alloying with carbon. Forty-eight elements were tried as additions to thorium, but most of them did not appreciably affect the strength when added in dilute quantities. Alloying with 0.25 weight per cent. of carbon, however, could double the tensile strength. In addition, precipitation hardening and cold working further enhanced the strength of the thorium-carbon alloys.

### The Institution of Telecommunication Engineers

The last date for receipt of applications for the first series of Graduateship and Studentship Examinations has been extended to March 15, instead of January 31, as announced earlier in this *Journal* (1955, 24, p. 434).

### Award of Research Degree

The Aligarh University has awarded the Ph.D. Degree in Geology to Shri H. Pareek for his thesis entitled, "The Petrological Study of Talcher Coals".

The University of Bombay has awarded the Ph.D. Degree in Physics to Sri. R. D. Joshi for his thesis entitled, "Some Spectral Problems connected with  $N_2$  Band System".

The University of Poona has awarded the Ph.D. Degree in Engineering to Shri K. R. Phadke for his thesis entitled, "Measurement of Atmospheric Noise Interference to Broadcasting in 3 and 5 Mc/s. bands at Poona".

# Current Science

Vol. XXV]

MARCH 1956

[No. 3

	PAGE		PAGE
<i>The Problem of Domestic Fuel</i> ..	73	<i>Survey and Classification of Indian Soils</i>	79
<i>Benjamin Franklin</i> .. ..	74	<i>Inference in Time Series</i> .. ..	80
<i>The Estimation of Mutation Rates Produced by High Energy Events in Mammals</i> —J. B. S. HALDANE .. ..	75	<i>Sir Cyril Hinshelwood</i> .. ..	80
<i>Sand Sorting on the East Coast Beaches</i> —C. BORRESWARA RAO AND E. C. LA FOND .. ..	77	<i>Letters to the Editor</i> .. ..	81
		<i>Reviews</i> .. ..	95
		<i>Science Notes and News</i> .. ..	100

## THE PROBLEM OF DOMESTIC FUEL\*

IN India at present, about 80 million tons of crowdung cake, equivalent to about 40 million tons of coal and about 35 million tons of fuel-wood, equivalent to about 19 million tons of coal, are being used as domestic fuel. All the fuel wood and charcoal is derived by cutting down trees in forests, wastelands and private gardens. Forest statistics indicate that afforestation is lagging far behind deforestation. The devastating results of deforestation and insufficient afforestation as well as of burning farm waste, such as severe soil erosion, extensive floods, irregular weather conditions and growth of waste lands are now well known. It is therefore imperative that in order to improve the fertility of the Indian soil and to develop the country's agricultural resources and production, the consumption of fuel wood, charcoal and farm waste must be cut down drastically, and the fuel habits of the public should be changed so as to replace the present fuels with coal and coal products.

If India is to have a rational fuel policy for the future, it is necessary to consider the present and the likely future patterns of energy utilisation in the country. Approximate estimates indicate that the annual total energy required by about 1970-75 would be about  $5,000 \times 10^{12}$  B.T.U. as against about  $3,600 \times 10^{12}$  B.T.U. at present. It is further estimated that the future energy pattern would include about 60% from coal, about 30% from wood and farm waste, and the rest from oil and hydropower. The present level of wood and farm waste consumption for fuel is therefore expected to be reduced by more than 50% and coal and oil energy correspondingly increased. Approximate calculations made on this basis show that about 20 million annual tons of semi-coke would be needed as domestic fuel, assuming that no increase would take place in future in the quantum of energy-derived from wood and farm waste. Likewise, the railways are also expected to expand in future in the direction of diesel and electric locomotion, reducing the present wasteful method of steam locomotion based on raw coal. It is thus

\* Abstract of the Presidential Address by Dr. S. Husain Zaheer to the Chemistry Section, 43rd Indian Science Congress, Agra, 1956.

clear that a rationalisation is absolutely essential in the development and utilisation of the fuel resources of the country if the fuel habits of the public are to progress from the 'cowdung age' to the 'coal age'.

It is not merely essential to bring about an overall rationalisation in energy utilisation in the country, but also in each sphere it is necessary to tap the right source for any desired purpose. In order to produce semi-coke by low temperature carbonisation, it is necessary from the view-point of conservation of high grade Indian coals, to depend mainly on non-caking coals, high-ash caking slacks and lignites which are unsuitable for use in blast furnaces. The reserves of non-caking coals up to 16% ash and lignites are estimated at about 8,000 million tons distributed all over India. The present demand for semi-coke in important cities and townships in the country is estimated to be more than 5 million annual tons. It is thus entirely feasible to establish a series of low temperature carbonisation plants in the important coal- and lignite-bearing areas of the country so as to regionalise production and facilitate distribution.

Enormous possibilities exist in this country for the development of low temperature carbonisation industry. On the basis of the types of coals available in our country, it would be desirable to establish plants in four major regions from the points of view of availability of raw materials and necessity for convenient distribution of smokeless domestic fuels. These regions are: Neyveli in Madras State, Kothagudium in Hyderabad State, Madhya Pradesh and Bengal-Bihar coalfields. It would be further necessary to instal suitable size tar distillation and processing and tar acid recovery plants to produce tar crudes or finer chemicals or other products as desired.

Dr. H. K. Sen was the first to draw the

attention of Indian scientists in 1940 to the possibilities of low temperature carbonisation of coal, and a plant designed by him is in operation at the Lac Research Institute, Ranchi. About five years ago, the Central Laboratories for Scientific and Industrial Research, Hyderabad, studied the low temperature carbonisation of non-caking coals available in large quantities in the State and decided to instal a 25 tons/day plant of Lurgi-Spuelgas type. The plant has been in intermittent operation since January 1954 and so far about 4,000 tons of coal have been processed. About 2,200 tons of semi-coke, 'coalsite' as it has been commercially termed, have been sold in the two cities of Secunderabad and Hyderabad as domestic fuel. The semi-coke is sufficiently hard to withstand all stages of handling and has proved a good domestic fuel. Two types of coal from Hyderabad coalfields were tested in this plant and further tests on the influence of temperature and time of carbonisation are in progress. A 3 tons/day tar distillation plant will be installed shortly to produce commercial products for direct sale and for recovery of tar acids and diesel oil. Laboratory investigations to increase the yield of pitch for road tar preparation by air-blowing are in progress. Work has also been taken up on extraction of pure tar acids from tar oils and liquors and the identification of tar acids by chromatography. Based on these tests, the Government of Hyderabad has submitted proposals for a 800 tons/day L.T.C. plant for inclusion in the Second Five-Year Plan of the State.

It is understood that proposals for such plants have also been submitted by various State Governments for inclusion in the Second Five-Year Plan. The total semi-coke production from all these proposals is expected to be about 2.9 million annual tons with about 360,000 tons of low temperature tar as by-products.

### BENJAMIN FRANKLIN

IN connection with the 250th Anniversary of Benjamin Franklin which is being celebrated in 1956 the world over, the following extract from a letter addressed by him to Joseph Priestley, dated February 8, 1780, will be read with great interest:

"The rapid Progress true Science now makes, occasions my regretting sometimes that I was born so soon. It is impossible to imagine the Height to which may be carried, in a thousand years, the Power of Man over Matter. We may perhaps learn to deprive large Masses of their Gravity, and give them

absolute Levity, for the sake of easy Transport. Agriculture may diminish its Labour and double its Produce; all Diseases may by sure means be prevented or cured, not excepting even that of Old Age, and our Lives lengthened at pleasure even beyond the antediluvian Standard. O that moral Science were in a fair way of Improvement, that Men would cease to be Wolves to one another, and that human Beings would at length learn what they now improperly call Humanity."

# THE ESTIMATION OF MUTATION RATES PRODUCED BY HIGH ENERGY EVENTS IN MAMMALS

J. B. S. HALDANE

University College, London

IT is feared that the dissemination of radioactive elements from thermonuclear explosions may cause numerous mutations in man. It is also important to know what risks to future generations are run in the industrial use of atomic fission, and in the mining of uranium and thorium. The problem cannot be studied experimentally in men; it can be studied in mice.

Most mutations detectable in *Drosophila* are recessive lethals. The same is probably true in mice. How shall we find out how many are produced by a given dose? If a male mouse receives a large dose, say 400 roentgens, it is at first sterilized, but on recovery it produces mutated gametes. Russell<sup>1</sup> irradiated males homozygous for 7 dominant genes, and mated them to recessives. He found 54 mutations of these 6 genes in 48,007 mice, as compared with 2 in an almost equal number of controls. But though about half of these were lethal when homozygous, we do not know what happened at the many thousands of other loci in their chromosomes.

Suppose we make up two stocks of mice, one homozygous for about 8 dominant genes AA BB CC..., the other for their corresponding recessives aa bb cc.... The genes can be for colour (for example recessive black) and structure (for example recessive wavy hair). Members of the recessive stock are irradiated during one or more generations, and a recessive mouse with irradiated ancestors is mated with a multiple dominant. A pair of their progeny is bred together, and a large F<sub>2</sub> generation is raised. Now suppose that, as the result of irradiation, the recessive grandparent is aL/al, where L is a normal gene and l a lethal on the same chromosome as the recessive gene a. Then in the absence of a lethal, we expect 1/4 n aa (recessive) mice in an F<sub>2</sub> of n members. In presence of a lethal we expect xn, where x = 1/3(c + c' - cc'), c and c' being the frequencies of recombination between a and l in the two sexes.

We shall suspect a lethal if our F<sub>2</sub> of n contains r or fewer recessives, where r is a function of n to be fixed in advance. The probability of suspecting a lethal which is not in

fact present is  $3^{n-r} 4^{-n} \sum_{i=0}^r 3^{r-i} \binom{n}{i}$ . We can

therefore choose r for each value of n so that this probability does not exceed some small quantity, say 1/300. In this case, for example r = 0 when n has any value from 20 to 27, and r = 1 when n has any value from 28 to 34.

Given our table of r as a function of n we ask what is the probability of detecting a lethal with given values of c and c'. This

$$\text{probability is } P(n, r, x) = \sum_{i=0}^r \binom{n}{i} x^i (1-x)^{n-i}.$$

This is unity when x = 0, but for values of n of the order of 40 it falls to 1/2 when x is about .06, or c and c' about .09. We then ask, assuming c = c', what is the mean length of "linkage map" of the chromosome searched. It is

$$s = \int_0^{\frac{1}{2}} P(n, r, x) dx$$

The chromosome is searched on both sides of the locus of a, but it is only searched in one half of the F<sub>2</sub> families examined.

Now

$$\frac{dc}{dx} = \frac{3}{2} (1-3x)^{-\frac{1}{2}},$$

so

$$s = \frac{3}{2} \int_0^{\frac{1}{2}} P(n, r, x) (1-3x)^{-\frac{1}{2}} dx.$$

But we have chosen r so that P(n, r, 1/4) is negligible, while P(n, r, 0) = 1. So we can put, with a small error

$$\begin{aligned} s &= \frac{3}{2} \int_0^1 P(n, r, x) (1-3x)^{-\frac{1}{2}} dx \\ &= \frac{3}{2} \int_0^1 P(n, r, x) \left( 1 + \frac{3}{2} x + \frac{27}{8} x^2 + \dots \right) dx \end{aligned}$$

Now

$$\begin{aligned} \int_0^1 x^k P(n, r, x) dx &= \sum_{i=0}^r \binom{n}{i} \int_0^1 x^{i+k} (1-x)^{n-i} dx \\ &= \sum_{i=0}^r \frac{(i+1)(i+2)\dots(i+k)}{(n+1)(n+2)\dots(n+k+1)} \\ &= \frac{(r+1)(r+2)(r+3)\dots(r+k+1)}{(k+1)(n+1)(n+2)\dots(n+k+1)} \end{aligned}$$



Hence we find

$$s = 6(r+1) [4n-3r-2+O(n^{-1})]^{-1}.$$

It is usual to measure map distances on the chromosomes in units corresponding to 1 per cent. recombination. So, for example, the examination of an  $F_2$  of 30 mice, a lethal gene being suspected if  $r=1$ , that is to say if one or no recessives are present, will, on an average, search 10.4 such units (centimorgans). The details of mouse genetics enable a somewhat greater length to be searched in some cases. As the total map length of the autosomes is about 1,700 centimorgans it should be possible to search about 5 per cent. of it if the average number in an  $F_2$  examined is about 30.

However, owing to the concentration of genes in certain parts of the linkage map, it is likely that the fraction detected will somewhat exceed 5 per cent.

We have no clear idea of how many lethals to expect. We might for example search chromosomes which, in several irradiated generations, have received a total dose of 1,200 roentgens. The production of lethals in *Drosophila* spermatozoa is about 1 per 10,000 roentgens, and perhaps 1 per 40,000 if the animals are steadily irradiated through their life-cycle. But a mouse has 30 times as much desoxyribonucleic acid per nucleus as a *Drosophila*. If this is equally radiosensitive (which is a mere guess) we should expect about one lethal in a mouse whose chromosomes (or rather their ancestors) have received 1,200 r. We should detect this, on an average, once in 20  $F_2$ 's examined. This would involve the examination of about 600 mice, and the breeding of about 800. The proof that a lethal was present might entail the examination of another hundred or so. Thus the breeding of 10,000 mice would either give an estimate of the frequency with which lethal genes are produced, or show that it is much less frequent than the above guess (which is rather below the frequency deduced from an extrapolation from Russell's data) suggests.

If the frequency is anywhere near the order suggested, it would be quite practicable to repeat the experiment on mice whose ancestors,

for many generations, have received a dose throughout life of less than one roentgen per day. In such circumstances one would expect to find very few lethals due to the recombination, in abnormal patterns, of chromosomes in which two simultaneous breaks have occurred. These are probably common where massive doses are given in a short time.

It is further desirable that a rough comparison of the frequencies of mutation of human genes and mouse genes should be carried out. This could probably be done by irradiating tissue cultures in which the cells carry a genetically determined antigen such as B. Cells lacking it would not be killed by a powerful anti-B serum. Care would have to be taken to distinguish between the effects of mutation and somatic crossing over in removing the gene producing the B antigen.

My reason for publishing in India this very condensed summary of a paper which, I hope, will appear elsewhere in full, is as follows. The method described may well be used in one of the States which are making atomic bombs or is allied with such a State. In such a State there will inevitably be a tendency, if not to suppress results which might suggest that these bombs were dangerous to the whole world population, at least to minimize their importance. In India or Japan there will be an equal tendency to exaggerate them. If the results obtained in countries of both types are in substantial agreement, truth will probably have been achieved.

It can be argued that the suggested experiment is cruel to the mice concerned. However, irradiation is painless, and most of the lethal genes will probably act before birth or immediately afterwards. It is certainly less cruel than the destruction of mice by many of the types of poison and trap which are in common use, or even by cats, which seldom kill mice quickly. Nevertheless I must admit that some mice will be born with potentially painful diseases. I can only say that, perhaps wrongly, I prefer to contemplate such conditions in mice rather than men.

## SAND SORTING ON THE EAST COAST BEACHES

C. BORRESWARA RAO AND E. C. LA FOND

*Andhra University, Waltair*

THE beach is a zone of interaction between sea, land and atmosphere. By virtue of the properties of, and the forces in, these three media, the beach becomes a continuous sorting ground for the sediments deposited there by rivers, by coastal erosion, and by other means. The material is sorted according to size, the coarse sand remaining on the beach, thereby the finer sediments being carried progressively further out to sea. The sand is also sorted according to density, that is, the lighter mineral sand grains are separated from the heavier mineral concentrates. Because of its scientific and economic importance considerable study has been devoted to this sorting feature.

Under the Andhra University's Oceanographic Programme and the Scheme sponsored by the Department of Atomic Energy, the nature, origin, and distribution of heavy mineral sands occurring along the east coast off Visakhapatnam have been studied and reported.<sup>1-6</sup> This present study deals with a new aspect, namely, the deposition and sorting of heavy mineral sands on the beach at the confluence of rivers. To achieve this, repeated surveys have been carried out along the coastal strips and river banks near the confluences of the Vamsadhara, Nagavali, Vainateyam and Vasishta Godavari rivers.

On each survey the distribution of heavy mineral concentrates, both laterally and with depths down to the level of the water table, was recorded. Additional information was also obtained on sand levels, tide heights, wind, waves, current, river run-off and related factors which control deposition and sorting. In order to provide a seasonal trend in sand conditions at these confluences, the surveys covered the periods of February-March, August-September, and November-December.

With the exception of the Vainateyam river, the distribution of sorted sand was found to be similar. The northern coastal strips near the confluences of Vamsadhara and Nagavali rivers consisted of well-sorted concentrates of heavy minerals, with decreasing richness northwards. In contrast, the southern coastal areas were composed of ill-sorted mixed sands. Likewise, the beach strip east of the Vasishta Godavari confluence and the eastern bank of the river contained well-sorted heavy mineral patches, decreasing eastwards. Here, too, the

western bank contained mixed sand, except for a few minor patches of heavy black sands. This unilateral distribution and relative richness of heavy mineral concentrates typical of each of the above three rivers, is graphically represented in Fig. 1.

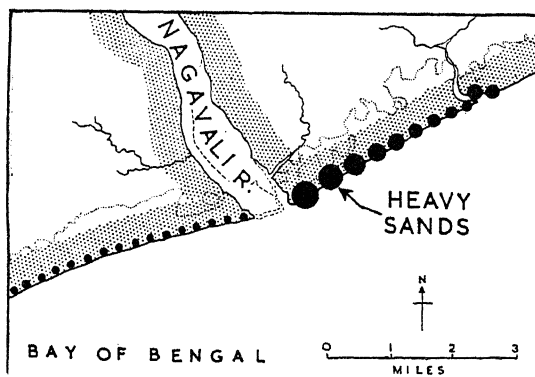


FIG. 1. Location and comparative abundance of heavy mineral sands at river confluences.

The materials from which both the light and heavy mineral sands derive have been transported to the coast by the major and minor drainage systems of the area, with a small amount from erosion of the coast itself and from offshore deposits. At the confluences this mixture is subjected to the processes of deposition and sorting.

The period of maximum river flow and sand deposition occurs in August-September. Under such turbulent conditions the eroded sediments are carried in suspension or flow along the river bottom. As the river approaches the confluence a shoal bar of sand extending from the south or west bank changes its direction and reduces its speed of flow. This deflection of direction is augmented by the drift of the slow northerly current along the beach, and by the predominate swell and waves from the south.

The deposition of material is brought about mainly by the reduced speed and turbulence in the river as it reaches the confluence. This slackening in speed is further affected by the spreading out of the river over its delta and by the deepening of the water in the Bay beyond the sand bank. The higher sea-level, lower sand-level, and larger waves at this time of the year facilitate deposition over a large

area. The waves striking the beach from a southerly angle tend to deposit the sand mixture on the left-hand side of the confluence. The predominant northerly flow of sand along the beach allows little of the river deposited material to accumulate to the south or west of the confluence. These, then, are the factors instrumental in producing a deposit of ill-sorted sand, especially off the north and east side of the river mouth. See Fig. 2A.

The wind also acts as a sand sorter by blowing away the light dry sands, sometimes to form sand dunes, and leaving a thin dark heavy mineral layer on the surface of the upper beach. Therefore, the sorting results in layers and patches of heavy minerals interspersed with lighter sands. Heavy minerals concentrate, particularly at the high tide level.

Sorting is a continual process, though its effect reaches a maximum in the February-

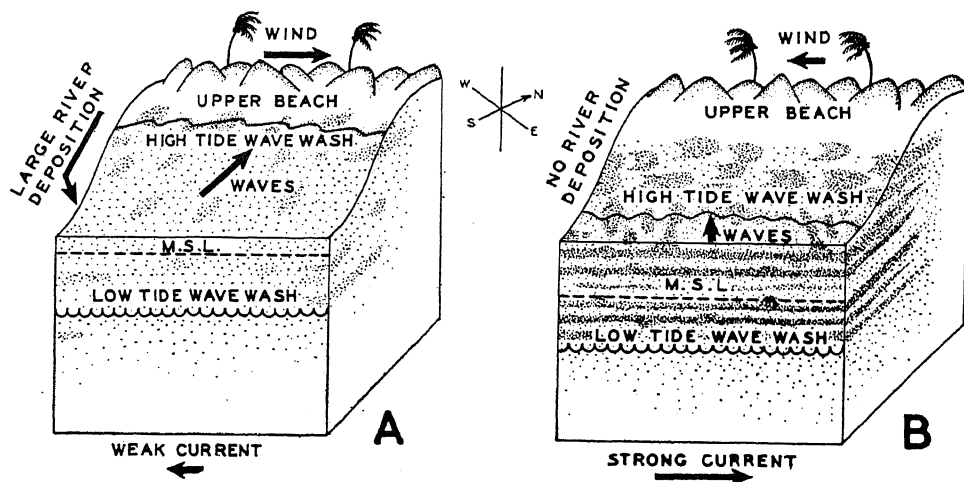


FIG. 2. Environmental conditions on the beach when sand is (A) deposited in August and (B) sorted in February.

The newly deposited sand is loosely packed and is easily subjected to the sorting action of the waves, tides, currents and wind. The waves break at different levels on the beach depending upon their size, and upon the relative levels of the sea, tide and sand. As the waves break, they churn sand into suspension from which it is easily moved along the beach by the near-shore current. However, the lighter sands remain in suspension longer and are transported faster and farther, leaving behind the denser heavy mineral sands. Also, the long sweep of the swash and backwash of the larger waves develops a panning action, bringing the lighter sands to the surface and thus making them more available for transport up the coast. Though some heavy materials may be transported short distances, the heavy fractions tend to accumulate at the confluences, especially on the north side where most of the river sediments are deposited.

The beach sands are not sorted uniformly because the waves, tides, currents, etc., are not constant. Under quiet conditions, there exists a shoreward "creep" of off-shore sediments, and during storms the movement is towards

March period. At this time, the sea-level is at a minimum, the waves are lowest, and the deposition of mixed material by the rivers is relatively small or virtually nil. See Fig. 2B.

In summary, the river sediments are deposited largely on the north and east side of the confluence. Here sorting takes place through the combined action of waves, currents, tides, sea-level, and wind. The lighter component is carried away leaving layers and patches of heavy mineral concentrates, which decrease in richness to the north and east of the confluences. Thus can be explained the unilateral distribution of these heavy mineral sands along the east coast beaches.

1. Mahadevan, C. and Sriramadas, A., *Proc. Indian Acad. Sci.*, 1948, **27A**, No. (4), 275-78.
2. —, and Sathapathi, N., *Curr. Sci.*, 1948, **17**, 297.
3. —, and Nateswara Rao, B., *Ibid.*, 1950, **19**, 48-49.
4. Sriramadas, A., *Quart. J. Geo. Min. Met. Assoc. India*, 1951, **23** (4), 169-180.
5. La Fond, E. C. and Prasada Rao, R., *Andhra University Memoirs in Oceanography*, 1954, **1**, 63-77.
6. Mahadevan, C. and Sriramadas, A., *Ibid.*, 1954, **1**, 57-62.

## SURVEY AND CLASSIFICATION OF INDIAN SOILS\*

THE prime necessity of present-day Indian agriculture is a well-planned, well-understood and well-carried out programme of soil management in order that the soil would continue to produce satisfactorily in accordance with its capabilities. For this purpose, the necessity for manuring and fertilization, crop rotation as well as appropriate tillage at the right time under the right conditions should receive their full attention.

The deficiency of nitrogen in all Indian soils demands the highest priority to be given to the production and use of nitrogenous fertilizers. Manurial experiments at the State Agricultural Laboratories have indicated vast potentialities of increasing crop production by the use of plant food elements in the form of simple mineral salts. But the cultivators need to be educated by demonstrations and propaganda about the concept of mineral nutrition of plants. Under the Second Five-Year Plan, the Indian Council of Agricultural Research have initiated a model scheme on simple manurial trials on cultivators' fields all over the country.

Soil testing forms an integral part of advisory services offered to farmers inasmuch as specific nutrient deficiencies must be detected and remedied in time in order to maintain productivity of the soil at the optimum level. Twenty-four soil testing laboratories are to be established in different regions of the country for this purpose.

There have been a good number of soil surveys of limited areas with specific objectives such as fertility surveys, pre-irrigation and post-irrigation surveys and genetic surveys. However, the basic knowledge of the soil types which form the physical basis for land use is still incomplete.

Genetical soil studies and classification of soils based on morphology, physical, chemical and mineralogical compositions, are comparatively recent developments in India. Reference may be made to the study of Lateritic and Red soils by Sen and Deb (1941) and Raychaudhuri and co-workers (1941, 1942 and 1944), Kumaon Hill soils at Chaubatia in Uttar Pradesh by Mukherjee and Dass (1940), soils of

the canal zones of Bombay-Deccan by Basu and Sirur (1938) and the effect of climate, vegetation and topography on the formation of the soil by Raychaudhuri and Mathur (1954).

In connection with irrigation projects, extensive soil studies have been carried out to determine the water relation of soils and to classify them into those suited and unsuited for irrigation. Soil conservation surveys including soil erosion and land utilization for soil and water conservation have also been attended to in some of the States, like Bombay, Damodar Valley Corporation (Bihar) and Uttar Pradesh. In the light of the information available in India and other countries, a survey procedure suitable for Indian conditions needs also to be evolved. In this connection, a Central Soil Conservation Board has been established, the main functions of which are to organise, co-ordinate and initiate research in soil conservation, to arrange for the training of technical personnel and rendering financial assistance.

Under the U.S. programme, soil survey is being carried out in forty centres throughout India on soil climate basis. But a great deal of field research is necessary to correlate combinations of soil characteristics as determined by detailed morphological studies in the field, and chemical, physical and mineralogical studies in the laboratory, with the geomorphological characteristics of the landscape and responses of the soils to management. The All-India Soil Survey on a soil-region basis has therefore been planned and four regional centres are proposed to be established.

The first need for soil surveys in India is classification and nomenclature according to carefully defined units of the lower categories. Units need to be based upon both external and internal characteristics of soils as landscapes with special emphasis on detailed morphological studies, using standard methods and terms for describing the individual characteristics. In view of the lack of adequate data on Indian soils, especially morphological data, a real need exists also for a first approximation to the higher categories of classification. Since several countries are directly concerned with well-developed soils in tropical and equatorial regions, the great advantages of international co-operation and agreement on the broad groups and nomenclature of soils in the tropics and equatorial regions are obvious.

\* Abstract of the Presidential Address to the Section of Agricultural Sciences, by Dr. S. P. Raychaudhuri at the 43rd Session of the Indian Science Congress, Agra, 1956.

## INFERENCE IN TIME SERIES\*

**B**Y time series is meant data in the form of one or more records of observed magnitudes arranged in order of time. Sometimes we have a continuous record of observations, and at other times the record is a sequence (or sequences) of magnitudes observed at equal intervals of time. These are known respectively as continuous and discrete time series. Geophysical and meteorological time series can be observed over a long period, the annual conditions of weather remaining more or less the same over this long stretch of time. However, time series referring to economic phenomena, are generally short because economic conditions undergo abrupt changes now and then.

The conventional analysis of time series into trend, cyclical part, and the residual, is superficial. Earlier work on time series refers mostly to trend-fitting and periodogram construction. Some tests of significance have already been considered in respect of elimination of trend, significance of harmonic analysis, and autocorrelation. More recently, large sample tests of goodness of fit for auto-regressive and moving average models have also been constructed by a number of workers.

By 1947, time became ripe for the initiation of the classical procedures of statistical inference into time series studies. The work of A. Kolmogoroff (1933) and J. L. Doob (1937) has validated the use of a probability measure in function spaces of time series in a number of cases, if not universally. H. Cramér's spectral representation of stationary processes (1942) and the subsequent work of K. Karhunen (1947) have provided new and powerful tools for the study of time series from the standpoint of stochastic processes.

Frequently, the specification of time series does not go beyond stationarity or the Markoff property. As such, an explicit functional formulation of the likelihood is not possible except in the special cases of processes which are

also known to be Gaussian. Thus, maximum likelihood estimation procedure is of limited application in time series studies. The usual criteria of consistency, unbiasedness and minimum variance can, however, be taken over into studies on inference in time series. In 1950, U. Grenander has shown how the concept of the likelihood ratio of Neyman-Pearson theory can be brought over into the study of time series with the help of Radon-Nikodym theorem. He has considered the problem of estimation of the mean value function and of the mean value constant which it takes in the case of stationary processes. In the latter case, the time average of the recorded observations is an unbiased and asymptotically efficient estimate of the unknown mean value. However, U. Grenander (1950) and K. Nagabhushanam (1952) have shown that it is not necessarily the minimum variance estimate. Optimal estimation is generally found to depend on the solution of an integral equation. K. Nagabhushanam (1951) has obtained an integral equation for optimal prediction of the primary process of a linear relationship which reduces by suitable specialization to Levinson's form of Wiener's integral equation for prediction with filtering.

One of the fascinating fields of study relating to inference in time series is the estimation of the spectrum of a stationary process. The classical periodogram is only an asymptotically unbiased estimate of the spectral intensity and not a consistent estimate of it. Daniell, U. Grenander, and M. S. Bartlett were led to a consideration of weighted sums of periodogram ordinates for obtaining consistent estimates of the spectral density. The need to enlarge the specification of processes to include the cases of stationary processes whose spectra contain the saltus part also is vital to a spectral study of the problem of search for hidden periodicities. It now appears that this can be done, and we can have a positive line of approach to this classical problem of detection of periodicities in a trend-eliminated stationary time series.

\* Abstract of the Presidential Address to the Section of Statistics, by Prof. K. Nagabhushanam, at the 43rd Session of the Indian Science Congress, held at Agra, 1956.

## SIR CYRIL HINSHELWOOD

**S**IR CYRIL HINSHELWOOD, Dr. Lee's Professor of Chemistry in the University of Oxford, has been elected the new President of the Royal Society. Sir Cyril is known internationally both for his researches as a physical chemist, and as Foreign Secretary of the Royal Society since 1950. His researches on

complex chemical reactions have thrown new light on fundamental processes in biological systems. He also contributed to the British war-time research programme in chemistry. He has been the recipient of many medals including Davy and Royal Medals.

## LETTERS TO THE EDITOR

	PAGE		PAGE
Unit Cell Dimensions and Space Group of Copper Ethyl Sulphate—S. SWAMINATHAN, S. R. SIVARAJAN AND R. V. G. SUNDARA RAO .. .. .	81	Relationship between Flowering Age and Height in <i>Saccharum spontaneum</i> Linn.—S. L. SHARMA, R. C. SRIVASTAVA, M. N. ALAM AND J. P. TRIVEDI .. .. .	89
Reduced Temperature Scales—S. T. BOWDEN .. .. .	82	Some Observations on <i>Riccia discolor</i> L. & L.—B. S. VENKATACHALA .. .. .	89
On the Gravitational Field of Distant Rotating Masses—D. N. MOGHE AND R. V. WAGH .. .. .	83	Effects of Total Body X-Ray Irradiation on the Levels of Tryptophane and Nicotinic Acid in Liver and Kidney of Rats—MISS SHANTOO U. GURNANI, U. S. KUMTA AND M. B. SAHASRABUDHE .. .. .	90
On the So-called "Macrocephalus Beds" of Kutch—S. K. AGRAWAL .. .. .	84	Occurrence of <i>Corynebacterium renale</i> in Goats—M. R. DHANDA, P. CHANDRA SEKARIAH, J. M. LALL AND R. N. SETH .. .. .	92
Periodic Classification and Electronic Configuration of Elements—K. K. SUGATHAN AND T. C. K. MENON .. .. .	85	New Species of Marine Bacteria Tolerating High Concentrations of Copper—A. SREENIVASAN .. .. .	92
Adsorption of Iodine on Cellulose from Organic Solvents—A. G. CHITALE .. .. .	85	A New Bacterial Leaf-Spot on <i>Cleome monophylla</i> —S. G. ABHYANKAR, M. K. PATEL AND M. J. THIRUMALACHAR .. .. .	93
Condensation of o-Aminophenol with Aromatic Aldehydes—V. V. SOMAYAJULU AND N. V. SUBBA RAO .. .. .	86	Effect of Temperature on Development of Miracidia of <i>Gigantocotyle explanatum</i> (Paramphistomatidae: Trematoda)—KR. SURESH SINGH .. .. .	93
Arrangement of Afferent Branchial Arteries in <i>Anabas testudineus</i> —DEVENDRA B. SAXENA .. .. .	87	A Method for Obtaining Algal Cultures Free from Associated Micro-Organisms—U. S. GUPTA, K. L. MAHESHWARI AND S. R. SENGUPTA .. .. .	94
The Tonoplast in Yeast—N. V. ASWATHA NARAYANA .. .. .	88		

### UNIT CELL DIMENSIONS AND SPACE GROUP OF COPPER ETHYL SULPHATE

THE crystal  $\text{Cu}(\text{C}_2\text{H}_5\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$  belongs to the orthorhombic class,  $D_{2h}^{15}$  and crystallizes as long needles when grown rapidly from solution. The axial ratios from Hiordthal's measurements as reported in Groth (*Chemische Kristallographie*, Vol. 3, page 123), are:

$$a : b : c = 0.7491 : 1 : 0.6744$$

In the present investigation the axes are re-named in order to correspond with the space group listed in the *International Tables*, namely, *Pbca*, to which the crystal belongs. Thus the Groth axes *a*, *b* and *c* are re-named *b*, *a* and *c* respectively.

Using  $\text{CuK}_\alpha$  radiation, oscillation, rotation pictures and Weissenberg photographs of the zero and higher layers were taken about the *b* and *a* axes. The unit cell dimensions are:  $a = 9.73 \text{ \AA}$ ,  $b = 7.30 \text{ \AA}$ ,  $c = 19.70 \text{ \AA}$ .

The axial ratios reported in Groth were obtained on the basis of the measurements of only the four interfacial angles  $(001) \wedge (111)$ ,  $(010) \wedge (111)$ ,  $(100) \wedge (111)$ ,  $(111) \wedge (11\bar{1})$ . The *c* axis obtained from X-ray methods is seen to be thrice the Groth axis, for this alone makes the reported axial ratios possible. Thus the plane which Hiordthal assumed as  $(111)$  is actually  $(331)$ . Assuming its new indices and the unit cell dimensions, the interfacial angles are exactly the same as those measured or calculated by Hiordthal.

The systematic absences in the zero, first and second layer Weissenberg photographs about the *b* axis, and the zero layer picture about the *a* axis are as follows:

*hkl* none; all present

$0kl$  absent if  $k = 2n + 1$ ;

$h0l$  absent if  $l = 2n + 1$ ;

$hk0$  absent if  $h = 2n + 1$ ;

$h00$  absent if  $h = 2n + 1$ ;

$0k0$  absent if  $k = 2n + 1$ ;

$00l$  absent if  $l = 2n + 1$ .

Therefore, the space group is  $Pbca$ .

The experimentally determined density is  $1.79 \text{ g./cm}^3$ . It was thought necessary to determine the number of water molecules in one molecule of the crystal and a detailed chemical analysis confirmed the composition to be  $\text{Cu}(\text{C}_2\text{H}_3\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$ . These data give the number of molecules per unit cell to be four.

Complete structure analysis is in progress. The authors thank Prof. R. S. Krishnan for his kind interest in the work.

Dept. of Physics, S. SWAMINATHAN.  
Indian Inst. of Sci., S. R. SIVARAJAN.  
Bangalore-3, R. V. G. SUNDARA RAO.  
February 14, 1956.

## REDUCED TEMPERATURE SCALES

ALTHOUGH the significance of the van der Waals reduced temperature  $T/T_c$  is well understood, there appears to be some confusion regarding the so-called reduced temperatures proposed by Bauer, Magat and Surdin<sup>1</sup> and by Sibaiya and Rao.<sup>2</sup>

For the purpose of expressing the variation of surface tension with temperature, the latter investigators assume that the Lindemann formula is applicable to a liquid at any temperature and may thus be combined with the Eötvös equation to give

$$\gamma = \gamma_f \left( \frac{V_f}{V} \right)^{\frac{2}{3}} \left( \frac{T_c - T}{T_c - T_f} \right) = \gamma_f \left( \frac{V_f}{V} \right)^{\frac{2}{3}} \theta' \quad (1)$$

where  $\gamma$  and  $\gamma_f$  are the surface tensions at temperature  $T$  and freezing point  $T_f$ , respectively,  $V$  and  $V_f$  are the corresponding molar volumes, and  $T_c$  is the critical temperature of the substance. Such an assumption, however, is unnecessary inasmuch as division of the Eötvös equation for the system at the temperature  $T$

$$\gamma V^{\frac{2}{3}} = k (T_c - T)$$

by that for the system at the freezing point  $T_f$

$$\gamma_f V_f^{\frac{2}{3}} = k (T_c - T_f)$$

yields (1) directly. It may be noted that the function assumes all values between 1 and 0 as the temperature is raised from  $T_f$  to  $T_c$ .

The reduced temperature proposed by Bauer, Magat and Surdin is defined by

$$\theta = \frac{T - T_f}{T_c - T_f}$$

where  $T_f$  is the melting point, or more correctly, the temperature corresponding to the triple point. Although Scott and Dillon<sup>3</sup> state that "L. Sibaiya and M. R. Rao have also hit upon the idea of the reduced temperature  $\theta$ ," it is now evident that the relation between the two functions is

$$\theta = 1 - \theta'.$$

Scott and Dillon point out that it should be possible to invent other reduced temperature scales but that "no such scale for liquids would have the same general significance or usefulness as the  $\theta$ -scale of Bauer, Magat and Surdin". It may be shown, however, that the scale retains its essential significance when  $T_f$  is replaced by an arbitrary temperature. Thus the value of a particular property  $P$  (such as orthobaric density difference, surface tension, heat of vaporisation<sup>4</sup>) may be expressed by a power law of the type

$$P = P_0 (1 - T/T_c)^n$$

where  $P_0$  is a specific constant and  $n$  is very nearly a general constant for non-associated liquids. If  $P_1$  is the value of the property at the temperature  $T_1$ , then

$$P = P_1 \left( \frac{T_c - T}{T_c - T_1} \right)^n$$

Since

$$T_c - T_1 = (T_c - T) + (T - T_1),$$

we have

$$P = P_1 \left( 1 - \frac{T - T_1}{T_c - T_1} \right)^n$$

which is of the same form as the equation of Bauer, Magat and Surdin. Since  $T_1$  may take any value below  $T_c$ , it is evident that we may set up any number of such functions with the same general significance inasmuch as their use in this way reveals the same underlying attribute of the system. Moreover, from the standpoint of general utility the above formulation has the advantage that the second reference temperature need not be the freezing point (where, apart from the difficulties attending the experimental measurements, the internal structure of the liquid may be different from that at higher temperatures), but the temperature at which the particular pro-

perty may be measured with the highest precision.

Chemistry Dept.,  
University College, Cardiff,  
Wales, December 1, 1955.

S. T. BOWDEN.

1. Bauer, E., Magat, M. and Surdin, M., *Trans. Faraday Soc.*, 1937, **33**, 81.
2. Sibiaya, L. and Rao, M. R., *Curr. Sci.*, 1939, **8**, 359.
3. Scott, A. F. and Dillon, R., *J. Chem. Physics*, 1949, **17**, 1179.
4. Jones, W. J. and Bowden, S. T., *Phil. Mag.*, 1946, [7], **36**, 480.

### ON THE GRAVITATIONAL FIELD OF DISTANT ROTATING MASSES

In a recent paper, Bass and Pirani<sup>1</sup> have discussed corrections to Thirring's calculations of the gravitational field near the centre of a rotating spherical shell by introducing an additional term  $E^{\mu\nu}$  representing the elastic interaction between particles of the shell, in the expression for the energy-momentum tensor  $T^{\mu\nu}$ . It is felt by the authors that, as a matter of fact, when  $T^{\mu\nu}$  is expressed as

$$T^{\mu\nu} = (\rho + 3p) v^\mu v^\nu - p g^{\mu\nu} \quad (1)$$

then, there is no necessity of introducing any additional term  $E^{\mu\nu}$  as the results can be obtained by the usual process of transformation from the Galilean to non-Galilean system of

$$-KT_{\mu\nu} = \begin{pmatrix} 2m \sin^2 \theta \{ \omega^2 + r^2 \times (\omega \ddot{\omega} + \dot{\omega}^2) \} & 0 & 0 & 2mr \sin^2 \theta \dot{\omega} \\ 0 & -2mr^2 \sin^2 \theta \{ \omega^2 - r^2 \times (\omega \ddot{\omega} + \dot{\omega}^2) \} & 0 & 3mr^2 \sin \theta \cos \theta \omega \dot{\omega} \\ 0 & 0 & -2mr^2 \sin^4 \theta \{ \omega^2 - r^2 \times (\omega \ddot{\omega} + \dot{\omega}^2) \} & 0 \\ 2mrs \sin^2 \theta \omega \dot{\omega} & 3mr^2 \sin \theta \cos \theta \omega \dot{\omega} & 0 & 2m \{ \omega^2 + r^2 \sin^2 \theta \times (\omega \ddot{\omega} + \dot{\omega}^2) \} \end{pmatrix} \quad (5)$$

co-ordinates, as a result of which relation (1) is obtained.

It may be considered that the metric tensor  $g_{\mu\nu}$  in the non-Galilean co-ordinate system differs only slightly from its Galilean value. We may, therefore, express the metric as

$$ds^2 = -(1-a) (dr^2 + r^2 d\theta^2 + n^2 \sin^2 \theta d\phi^2) + (1+a) dt^2 \quad (2)$$

where  $a$  is a function of  $r$ ,  $\theta$  and  $t$  and is an infinitesimal of the first order. Its variations with respect to  $r$ ,  $\theta$ ,  $t$  are also very small, so

that we may neglect their products in the expression for  $T_{\nu}^{\mu}$ . We may then write  $T_{\nu}^{\mu}$  correct to the first order, as

$$-KT_{\nu}^{\mu} = \begin{pmatrix} \frac{\partial^2 a}{\partial t^2} & 0 & 0 & 0 \\ 0 & \frac{\partial^2 a}{\partial t^2} & \frac{\cot \theta}{2r^2} \cdot \frac{\partial a}{\partial t} & \\ 0 & 0 & \frac{\partial^2 a}{\partial t^2} & 0 \\ 0 & \frac{\cot \theta}{2} \cdot \frac{\partial a}{\partial t} & 0 & 0 \end{pmatrix} \quad (3)$$

where

$$\frac{\partial a}{\partial t} = 2R_0^2 \sin^2 \theta \chi^2 \Omega \dot{\Omega},$$

$$\frac{\partial^2 a}{\partial t^2} = 2R_0^2 \sin^2 \theta \chi^4 \{ \Omega \ddot{\Omega} + \Omega^2 \chi^2 (1 + 3R_0^2 \sin^2 \theta \Omega^2) \},$$

$a = 4\chi^2 + \text{constant}$  and

$$\chi = (1 - R_0^2 \Omega^2 \sin^2 \theta)^{-\frac{1}{2}}.$$

The density has a zero value as a first approximation.

If, however, we consider

$$T_2^1 = T_1^2 = 0,$$

then, we get

$$a = m (1 - r^2 \omega^2 \sin^2 \theta) \quad (4)$$

where  $m$  is an infinitesimal constant and  $\omega$  may be considered as the angular velocity. The effect of the rotating shell at any point of interest near the centre is given by

Other details have been worked out in a paper which is being communicated for publication elsewhere.

Meteorological Office,

D. N. MOGHE.

College of Engineering,

R. V. WAGH.

Poona-5, December 21, 1955.



## ON THE SO-CALLED "MACROCEPHALUS" BEDS OF KUTCH

JUDGING from the Jumara section,<sup>1</sup> roughly the middle and lower 'Chari' (now known as Habo<sup>6</sup>) series comprise what have been called by Spath the "macrocephalus beds". The age of these beds is debatable. In an earlier communication,<sup>6</sup> several species, e.g., *Macrocephalites chariensis*, *Indocephalites diadematus*, *Ceromyopsis aff. striata*, etc., have been shown to favour a Callovian age for them. Some additional observations and facts regarding certain occurrences and stratigraphy of these beds are put forward in the present note.

In the North-Western Kutch, these beds are known to be missing from the outcrops of Habo [Chari] series to the south of Bhuj. To the north of this town they occur towards the centre of the denuded Habo, Jhura, Jumara domes, etc. (for different localities see Raj Nath<sup>7</sup>). Spath is mistaken in stating that one of the "outcrop(s) of the macrocephalus beds is on Khera (= Keera) Hill near Chari...". Correctly speaking the Habo beds do not outcrop at all on the Keera Hill proper, which is an 'intrusive peak'. It is to the south of that 'trap hill' that one gets a quaquaversal arrangement of the Habo beds, forming Keera dome of Raj Nath.

Macrocephalitids, in general, are the dominant ammonites in these beds of Kutch and, according to Spath, "most of them are types such as occur in the English Cornbrash, even if there are no species in common". Numerous species of them have been recorded,<sup>2</sup> but *Macrocephalites macrocephalus* is yet unknown from this richly fossiliferous region of India. It is, therefore, very doubtful whether the use of this species as zonal index is justified for this area.

Spath further subdivides these Kutch beds into lower, middle and upper subdivisions. He finds, for one or the other reason, different Kutch species objectionable to serve as index-ammonites for these three horizons. Subsequently, he chose<sup>3</sup> two European species, *Kamptokephalites herveyi* and *Pleurocephalites tumidus*, to denote the middle and upper subdivisions respectively; and a Kutch form, *M. triangularis*, for lower horizon. This choice of *triangularis* is very unsatisfactory, since that species is not confined to lower macrocephalus beds but extends below into the Patcham beds also,<sup>4</sup> and only two examples of it have been recorded from Kutch. Moreover, the precise horizon of the holotype of *triangularis*, in Blake Collection in the British Museum

(Natural History), is uncertain. It came from 'bed 13 or 14a' of Jumara. In view of the correlation given by Spath, these two beds belong to two different groups; the former constitutes his lower macrocephalus beds ("Upper Bathonian"), whilst the latter is, evidently, to be included in the Patcham group ("Lower Bathonian"), although that author made no mention of this bed (14a) in his Jumara succession table.

*P. tumidus* is a Callovian form according to Spath himself, as pointed out in an earlier note<sup>5</sup> yet that ammonite specialist has included the 'upper macrocephalus beds' of Kutch in Upper Bathonian.<sup>5</sup> *K. herveyi* is a widespread Upper Cornbrash species. The Upper Cornbrash with *Macrocephalites* is quite distinct from the lower with *Clydoniceras*.<sup>8</sup> The faunal differences between these two divisions are of major importance. "The Lower or zone of *Clydoniceras discus* is Bathonian; the Upper or zone of *Macrocephalites macrocephalus* (auct.) is Callovian."<sup>9</sup> Hébert,<sup>10</sup> too, pointed out that macrocephalus and herveyi occur only in Callovian.

The lower Habo series of Jhura Hill has now yielded to me a well-preserved young example of *Camptonectes auritus* [lens]. Although this species has been recorded by some authors from Bajocian, Arkell has shown that in England, at least, it ranges from Upper Cornbrash onwards. In Kutch it is now known to range from lower Habo series upwards.

Lastly, Blake's "*Nucula flags*" of West Badi, belonging to "macrocephalus beds" (see Agrawal, loc. cit.), yielded to Blake an *Obtusicosites*—a genus ordinarily considered as Callovian. This occurrence, though needing confirmation by further collection, however, lends support for their Callovian age.

Laboratoire de Paléontologie, S. K. AGRAWAL.  
Muséum national d'Histoire naturelle,  
Paris, October 10, 1955.

1. Spath, L. F., *Pal. Indica*, N.S., 1927-33, 9, Mem. 2, Pt. VI, 740.

2. —, *op. cit.*, Pt. III, 176, et seq.

3. —, *Ibid.*, Pt. VI, 674.

4. —, *Ibid.*, 714.

5. —, *Ibid.*, 872.

6. Agrawal, S. K., *Comptes rendus Acad. Sc. (Paris)*, 1955, 240, 1790.

7. Raj Nath, *Q. J. Geol. Min. Met. Soc. Ind.*, 1932, 4, 165, pl. XII.

8. Douglas, J. A. and Arkell, W. J., *Quart. J. Geol. Soc.*, 1928, 84, 117; 1932, 88, 112.

9. Cox, I. R. and Arkell, W. J., *A Survey of the Mollusca of the Br. Grt. Oolite Ser. (Pal. Soc., Lond.)*, 1: 50, II, Introduction.

10. Hébert, F., *Les Mers Anciennes et leurs rivages dans le Bassin de Paris*, 1857, 1: *Terr. Jur.*, 33.

# PERIODIC CLASSIFICATION AND ELECTRONIC CONFIGURATION OF ELEMENTS

THE arrangement of elements shown in Fig. 1 is intended to indicate periodicity as well as the electronic configuration (in the outer shells). A system of squares is adopted, and the tabulation of one period (the VIth) is given in full. Each square representing a period is divided into smaller squares, four for periods II and III, nine for IV and V, and sixteen for VI and VII. Each element is allotted one half of a square. The advantages of this allocation are: (1) The number of half squares corresponds to the number of elements in each period, 2, 8, 8, 18, 18, 32, 32. (2) Each square represents one orbital and therefore the half squares correspond to two electrons of opposite spins belonging to the same orbital. The division of each square into two follows the Pauli principle.

82Pb 207.21 5	73Ta 180.88 8	61Pm 144.7 11	55Cs 132.91 2
85At (210) 6	78Pt 195.23 9	68Er 167.2 10	56Ba 137.36 1
72Hf 178.6 7	60Nd 144.27 10	57La 138.92 6	62Sm 150.43 12
77Iv 193.1 7	67Ho 164.94 10	76Os 190.2 6	69Tm 169.4 12
59Pr 140.92 9	58Ce 140.13 8	63Eu 152.0 13	74W 183.92 9
66Dy 162.46 9	65Tb 159.2 8	70Yb 173.04 13	79Au 197.2 9
81Tl 204.39 4	64Gd 156.9 14	75Re 186.31 10	83Bi 209.00 6
84Po 210.0 4	71Lu 174.99 14	80Hg 200.61 10	86Rn 222 6

- One 6s electron transfers to 5d.
- Both 6s electrons transfer to 5d.

FIG. 1

H and He are allotted the halves of the single square representing the first period and the 1s orbital as well. In the second period, filling up of the electrons in the orbitals is done according to Hund's law<sup>1</sup> of maximum parallel spins, i.e., one electron is allotted to each of the p orbitals before the second one is added.

On further expansion to nine squares, the same order of filling up is followed, so that the typical elements occupy the same corner squares as in the previous periods. Thus periodicity also is shown. The remaining five

squares accommodate the ten transitional elements.

Following the same order of filling up (i.e., beginning diagonally from the top right-hand corner) after filling the upper half of the next square (5d<sup>1</sup>, lanthanum) one passes on to the next square which represents a 4f orbital. Then seven additional squares (enclosed by double lines) are filled up by the rare earth elements before the remaining 5d squares (enclosed by bold lines) are taken up. Thus the corner squares are left vacant for the typical elements. The transitional elements occupy corresponding positions in the expanded squares too. The arrangement in the last period is similar.

The recent publications of Ganesan<sup>2</sup> and Ramirez-Torres<sup>3</sup> have been of considerable help in drawing up this scheme.

Dept. of Chemistry, K. K. SUGATHAN.  
Sree Kerala Varma College, T. C. K. MENON.  
Trichur, January 5, 1956.

1. Syrkin, V. K. and Dyatkina, M. F., *Structure of Molecules and the Chemical Bond*. (London, Butterworths), 1950, 24.
2. Ganesan, A. S., *Curr. Sci.*, 1955, 24, 10.
3. Ramirez-Torres, O., *J. Chem. Education*, 1955, 32, 450.

## ADSORPTION OF IODINE ON CELLULOSE FROM ORGANIC SOLVENTS

IN adsorption from solution, the interaction between the solvent and the adsorbent plays an important part. A further complication is introduced if the solvent has a swelling action on the adsorbent as is frequently the case with cellulose. It was thought that the two effects can be separated by swelling the cellulose to the same extent in each case. This may be done by allowing the cellulose to swell in water, replacing water by a water-miscible organic solvent such as acetone or methanol, and then this may be replaced by the organic solvent to be studied. In this way, adsorption isotherms of iodine in benzene and in methanol solutions were obtained for viscose staple fibre. Isotherms were also obtained on unswollen viscose for the sake of comparison.

The experimental procedures for unswollen and swollen viscose were as follows: (a) *Unswollen Viscose*: 30 ml. of the iodine solution of known concentration were added to about 0.3 g. of dry viscose fibre in a 100 ml. glass-stoppered flask, kept at 30° C. for 2 hours with frequent shaking, and the equilibrium concentration measured by withdrawing a sample of the

solution and titrating against sodium thiosulphate of appropriate strength. (b) *Swollen viscose*: About 0.3 g. of viscose (on dry basis) was swollen by keeping immersed in water for about 1 hour. The water was removed by washing the material 4-5 times with acetone, and the acetone was then replaced by the solvent to be used. The loose plug of viscose containing the solvent was weighed to obtain the weight of the solvent held. A suitable correction was then applied for the dilution produced by this amount of the solvent. The remaining procedure, however, was same as for the unswollen viscose. The results are presented in Fig. 1.

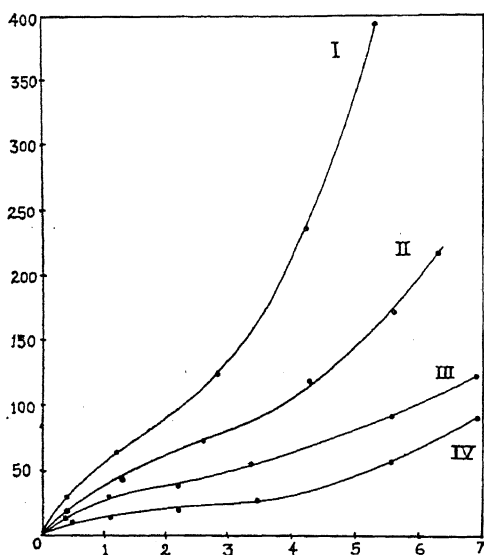


FIG. 1.  $x$ -Axis—Concentration of the iodine solution in g. per 100 ml.;  $y$ -Axis—Adsorption expressed as mg. of iodine per g. of viscose; I—from methanol on swollen viscose; II—from benzene on swollen viscose; III—from benzene on unswollen viscose; IV—from methanol on unswollen viscose.

All the isotherms give sigmoid curves and not the familiar curves obeying Freundlich equation. This indicates that multimolecular adsorption is present. On comparing curves III and IV for unswollen viscose, one finds that the adsorption is greater from benzene than from methanol. At first this seems surprising because methanol is known to have a much stronger swelling action than benzene and so it should make larger surface area available for adsorption. But if one considers the hydroxyl groups in cellulose as mainly responsible for adsorption, then one can see that many of them will form hydrogen bonds with methanol and thus may not be available

for adsorbing iodine. This of course will not happen in benzene solution. Moreover, although benzene as such has little swelling action on cellulose, a strong solution of iodine in benzene may exert some swelling action. As a matter of fact, during the study of adsorption on swollen viscose, the sample which was in the form of a plug was found to disintegrate in the stronger iodine solutions.

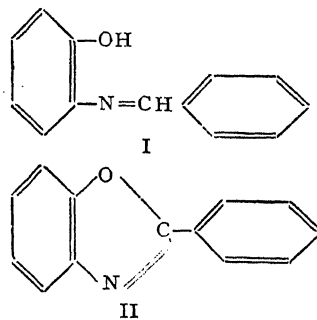
On the above hypothesis, the adsorption from benzene should be greater than that from methanol on the swollen viscose too; but actually from curves I and II, it is found not to be so. This may be explained in the following way. During the solvent exchange, the surface area does not remain constant and a certain amount of deswelling takes place when benzene is used as the final solvent. It is reasonable to expect that this will not happen with methanol. Thus the cellulose does not remain swollen to the same extent and so the adsorption from methanol turns out to be greater because of the larger surface available.

Chemistry Division,  
ATIRA, Ahmedabad-9,  
December 24, 1955.

A. G. CHITALE.

#### CONDENSATION OF *o*-AMINOPHENOL WITH AROMATIC ALDEHYDES

THE condensation of *o*-aminophenol and its derivatives with aromatic aldehydes was studied by a number of workers and Schiff's bases I were obtained.<sup>1-3</sup> Although these bases could not be converted to the corresponding benzoxazoles II by using hydrogen peroxide or potassium ferricyanide,<sup>4</sup> other dehydrogenating agents like lead tetracetate, chloranil, *N*-bromo succinimide and benzoyl peroxide could easily bring about the condensation.<sup>5-7</sup>



The results of investigation of the action of certain aromatic aldehydes on *o*-phenylenediamine carried out by Rao and Ratnam<sup>8</sup> in these laboratories prompted us to reinvestigate the condensation of some aromatic aldehydes with

o-aminophenol under varying conditions. During these investigations, nitrobenzene was found to be a very effective condensing agent resulting in the formation of benzoxazoles without the necessity of adding any oxidising agent. The yields of benzoxazoles were found to be uniformly good when equimolecular proportions of o-aminophenol and the aldehydes were refluxed in nitrobenzene medium for one and a half hours. The benzoxazoles could be isolated in some cases by steam distillation of the reaction mixture, nitrobenzene and the unreacted aldehydes distilling at first. In other cases, the solution, remaining after steam distillation of nitrobenzene and the unreacted aldehyde, was worked up to isolate the benzoxazole.

In all, fourteen aromatic aldehydes have been condensed with o-aminophenol, of which the reaction with the following six aldehydes, p-hydroxy benzaldehyde, vanillin, 3 : 4-dichlorobenzaldehyde, p-bromobenzaldehyde, 5-nitrosalicylaldehyde and  $\alpha$ -naphthaldehyde, has been studied for the first time.

The results are summarised in Table I.

TABLE I

Aldehyde condensed	Benzoxazole
Benzaldehyde	2-phenyl- (a)
Salicylaldehyde	2-(o-hydroxyphenyl)- (a)
p-Hydroxybenzaldehyde	2-(p-hydroxyphenyl)-* (b) m.p. 253°
Vanillin	2-(3'-methoxy-4'-hydroxyphenyl)-* (b) m.p. 166°
Anisaldehyde	2-(p-methoxyphenyl)- (b)
Piperonal	2-(3'-4'-methylene-dioxyphenyl)- (a)
p-Chlorobenzaldehyde	2-(p-chlorophenyl)- (a)
3 : 4-Dichlorobenzaldehyde	2-(3'-4'-dichlorophenyl)* (a) m.p. 144°
p-Bromobenzaldehyde	2-(p-bromophenyl)- ‡ (a)
m-Nitrobenzaldehyde	2-(m-nitrophenyl)- (c)
p-Nitrobenzaldehyde	2-(p-nitrophenyl)- † (c)
5-Nitrosalicylaldehyde	2-(2'-hydroxy-5'-nitrophenyl)-* (a) m.p. 191°
p-Dimethylamino-benzaldehyde	2-(p-dimethyl amino-phenyl)- (a)
$\alpha$ -Naphthaldehyde	2-( $\alpha$ -naphthyl)-‡ (b)

\* Compounds so far not reported in literature;

† Schiff's base was also isolated along with the benzoxazole; ‡ Compounds prepared earlier by different methods.

Method of Isolation :—(a) Steam distillation; (b) Residue crystallised from ethyl alcohol; (c) Residue crystallised from xylene.

Dept. of Chemistry,  
Osmania University,  
Hyderabad (Dn.),  
December 15, 1955.

V. V. SOMAYAJULU.  
N. V. SUBBA RAO.

1. Pictet, A. and Ankersmit, H., *Ann. d. Chem.*, 1891, 266, 138.
2. Ehmke, *Thesis, State University of Iowa*, 1940.
3. Raiford, L. C. and Linsk, J., *J. Amer. Chem. Soc.*, 1945, 67, 878.
4. Desai, K. D., Hinder, R. F. and Khalidi, A. R. K., *J. Chem. Soc.*, 1934, 1190.
5. Stephens, F. F., and Bower, J. D., *Ibid.*, 1949, 2971.
6. —, *Ibid.*, 1950, 1722.
7. Dyson, G. M. and Stephens, F. F., *British Patent*, 1952, April 2, 669, 402.
8. Rao, N. V. S. and Ratnam, C. V., *Curr. Sci.*, 1955, 24, 299.

### ARRANGEMENT OF AFFERENT BRANCHIAL ARTERIES IN ANABAS TESTUDINEUS

CARTER AND BEADLE<sup>1</sup> AND DAS<sup>2</sup> observed that the arterial supply of the blood in the air-breathing fishes is not of any special interest and very little attention has been given to the adaptive modifications in the afferent branchial arteries in fresh-water fishes, except by Das and Saxena,<sup>3</sup> Saxena,<sup>4</sup> and Das and Saxena.<sup>5</sup> Although a good deal of work has been done on the air-breathing habit and the accessory respiratory organs of *Anabas testudineus*, no account of the modifications of the circulatory system due to air-breathing habit exists.

The present work appears to be the first account of the afferent branchial arteries in *Anabas testudineus* Bloch (Perciformes; Anabantidae; Anabantidae). The ventral aorta extends from the ventral end of the third branchial arch upto the mid-distance between the second and first branchial arches where it terminates by bifurcating into the first pair of afferent arteries (Fig. 1). Along its course in

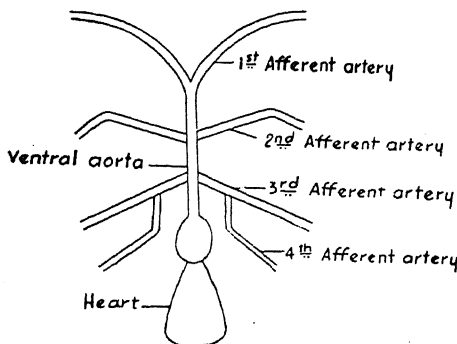


FIG. 1. Afferent branchial arteries in *Anabas testudineus*.

level with the ventral end of the second branchial arch, the ventral aorta gives off the second pair of afferent arteries. Just after piercing the pericardium a little anterior to the ventral

end of the third branchial arch, the third pair of afferent arteries originates from the ventral aorta. After a short distance of its origin the third afferent artery of each side gives rise from its dorsal aspect to the fourth afferent artery which is smaller than the former. The fourth afferent artery runs vertical to the third afferent artery for some distance before it curves posteriorly to supply the fourth gill-arch.

The second pair of afferent arteries (Fig. 2) originates from a single aperture in the dorsal

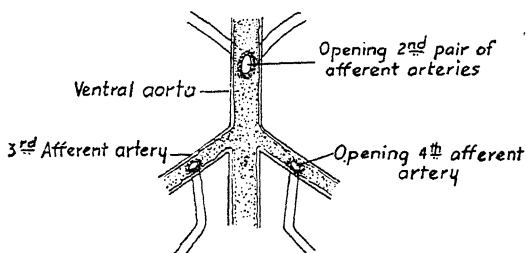


FIG. 2. A part of the ventral aorta and the third afferent branchial artery cut open to expose the origin of the second and fourth afferent arteries.

wall of the ventral aorta. The third pair of afferent arteries arise from separate openings in the lateral walls of the ventral aorta. The fourth afferent artery of each side originates from the roof of the third afferent artery. Thus the remarkable condition exists that the fourth pair of afferent arteries do not arise directly from the ventral aorta but from the third pair of afferent arteries.

The peculiar condition (recorded here for the first time) is not met with in any other Teleostomi (Berg.). It may be that the blood supply to the fourth gill-arch through a branch from the third afferent artery indicates the reduction and loss of the fourth afferent artery entirely, leaving the third afferent artery to supply the third as well as the fourth gill-arches. It is possible that this peculiar arrangement is correlated with the reduction of the fourth gill-arch. My sincere thanks are due to Dr. S. M. Das for his valuable guidance during the present investigations.

Dept. of Zoology, DEVENDRA B. SAXENA,  
The University, Lucknow,  
December 30, 1955.

1. Carter, G. S. and Beadle, L. C., *J. Linn. Soc.*, 1931, 37 (252), 327.
2. Das, B. K. *Proc. Indian Sci. Congr., Presidential Address*, 1940, 27 (2), 215.
3. Das, S. M. and Saxena, D. B., *Curr. Sci.*, 1954, 23 (4), 127.
4. Saxena, D. B., *Ibid.*, 1954, 23 (11), 363.
5. Das, S. M. and Saxena, D. B., *Sci. & Cult.*, 1955, 20, 560.

## THE TONOPLAST IN YEAST

IN deference to the then current belief that meristematic cells are bereft of vacuoles, deVries suggested<sup>1,2</sup> that vacuoles may be represented in meristematic cells by plastid-like primordia. To these he gave the name "tonoplasts". Guilliermond<sup>3</sup> concludes that in the embryonic cells of most plants the vacuolar system or vacuome exists in the form of minute inclusions (p. 220). According to deVries the tonoplasts enlarge by absorbing water. The formation of vacuoles is intimately related to tissue differentiation as well as secretory phenomena. Since vacuoles were conceived to originate from tonoplasts, the term tonoplast came finally to refer to the vacuolar membrane<sup>1</sup> (p. 19).

Guilliermond illustrates the appearance of yeast cells when examined under dark ground illumination. He remarks that only infrequently could the vacuole be made out by its luminous contour<sup>2</sup> (cell 4, Fig. 110, p. 165). Usually it is said to be invisible and could be located only by the luminous lipid particles surrounding it.

Examination of a 72-120 hr. culture of our control yeast strain, BY 1, in a galactose-

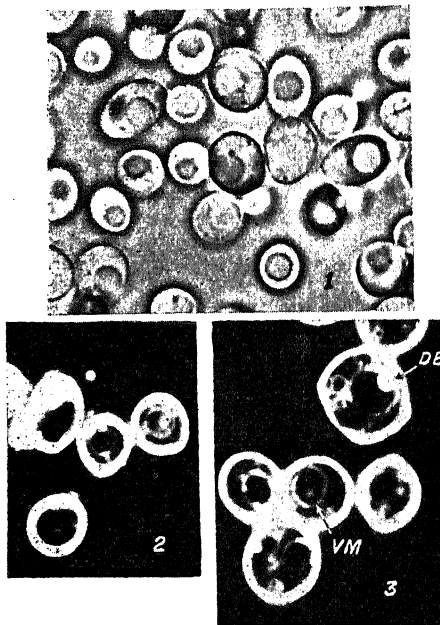


FIG. 1. Yeast cells from a 72-hr. culture. Light microscope.

FIG. 2. Cells from a 120-hr. culture. Dark ground illumination.

FIG. 3. Cells from a 12-day old culture. Dark ground illumination.

VM-Vacuolar Membrane; DB-Dancing Body

peptone-yeast extract medium shows the majority of cells to be vacuolated (Fig. 1). But when the same cells are observed under dark ground illumination, only in a few does the vacuole stand out by its luminous contour (Fig. 2). This engendered the suspicion that the vacuoles of older cells alone may have a definite membrane. Therefore, the cells mounted in the growth medium and sealed with paraffin were studied after the lapse of 7 days. The vacuoles in most cells had a luminous contour (Fig. 3). As will be seen, some of the cells have more than one vacuole.

A single grain, the 'dancing body', is present in most of the vacuoles (Fig. 3, DB) and since it is in active Brownian movement it is very difficult to photograph it. The limits of the vacuole lacking a luminous contour could often be surmised by the range of movement of the dancing body. Under the light microscope the dancing body is as clear as the vacuole in which it is present. Since often the dancing body alone is seen under the dark ground illumination one has to presume that only formed structures in cells are visible under this type of illumination.<sup>3</sup> Hence, when the dancing body is seen in a vacuole having a luminous contour (Fig. 3), it has to be surmised that there is a formed membrane delimiting the vacuole from the cytoplasm.

Can the vacuolar membrane of yeast be considered homologous to the tonoplasts of plant cells?

I am very grateful to Dr. M. K. Subramaniam for his guidance and encouragement.

N. V. ASWATHA NARAYANA.

Cytogenetics Lab.,  
Dept. of Biochemistry,  
Indian Inst. of Science,  
Bangalore-3, February 9, 1956.

1. Zirkle, C., *Bot. Rev.*, 1937, 3, 1.
2. Guilliermond, A., *The Cytoplasm of the Plant Cell*, Chronica Botanica Co., 1941.
3. Wolman, M., *Internat. Rev. Cytology*, 1955, 4, 79.

## RELATIONSHIP BETWEEN FLOWERING AGE AND HEIGHT IN *SACCHARUM SPONTANEUM* LINN.

WHILE recording growth observations of wild *Saccharums* for the study of their desirable attributes with a view ultimately to use them as good progenitors of commercial canes, it was found that smaller forms of *S. spontaneum* flowered earlier in season while tall ones arrowed towards the end. The correlation coefficient between height of plant and number of days

after germination to flowering was as high as  $+0.94$ , the total number of pairs of observations being 17. The regression coefficient for the two was  $Y = 105.71 + 0.292 X$ , where  $X$  is the average height of plant in cm. and  $Y$  the number of days. In other words, an increase in the height of plant by 1 cm. over a base line of 105.71 cm. will delay flowering by 0.292 days. No correlation was found to exist between the time of flowering and relative growth rates of the different forms as calculated by Heath's formula<sup>1</sup> ( $H = Ae^{bt}$  where  $H$  is final height attained;  $A$  is the length attained by an initial time;  $e$  is the base of natural logarithm;  $b$  is the index of 'efficiency of plant as producer of new material'; and  $t$  is the time).

Grateful thanks are due to Sri. K. L. Khanna for kindly providing facilities for this work.

Central Sugarcane

Res. Station,

Pusa, Bihar,

July 12, 1955.

S. L. SHARMA.

R. C. SRIVASTAVA.

M. N. ALAM.

J. P. TRIVEDI.

1. Heath, O. V. S., *E. C. G. C. Repts. Rec. from Exptl. Stations*, 1930-31, Appendix 28, 1932.

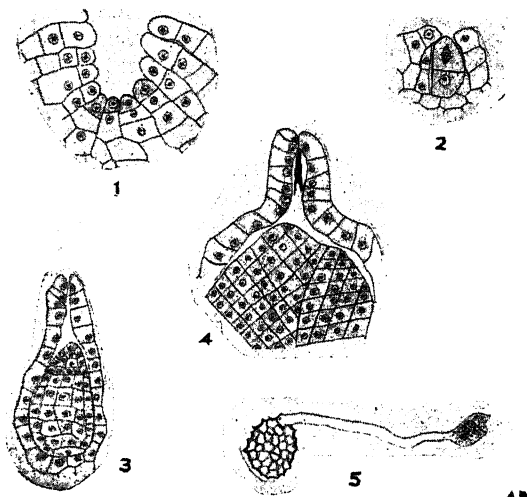
## SOME OBSERVATIONS ON *RICCIA DISCOLOR* L & L.

A DETAILED study of the life-history of *Riccia discolor* revealed certain interesting features, especially with regard to the sex organs and these have been included in this short paper. This species was described by Kashyap<sup>1</sup> as *Riccia himalayensis* but it seems to agree fully with the earlier description of *Riccia discolor* by Stephani,<sup>2</sup> a fact which has also been noted by Chopra<sup>3</sup> and by Pande and Ahmed.<sup>4</sup> In view of this the older name, *Riccia discolor* has been retained for the species under investigation.

The growing point of the thallus appears to be made of more than one cell, probably a row of two or more cells (Fig. 1). The development of the air-spaces is by the schizogenous method.

In this monœcious species, the archegonia are the first to appear followed later by the antheridia. The antheridia have, curiously enough, a small neck-like structure traversed by a canal. While the antheridial initials are dividing, the cells immediately surrounding them become distinct from the others with their rich contents and divide rapidly to form a conspicuous neck with several tiers of cells (Figs. 2, 3) almost comparable to the archegonial neck. The archegonial neck is, however, formed by the archegonial initial, while the neck-line structure

seen in the antheridium here is built up of the surrounding vegetative cells. It is very likely that the sperms are discharged through the canal which runs through the neck and connects the antheridial cavity with the exterior (Fig. 4). This is further supported by



FIGS. 1-5.—Fig. 1. Tr. sec. of thallus showing apical region,  $\times 210$ . Fig. 2. Antheridium initial in the two-celled stage, the upper cell in division,  $\times 210$ . Fig. 3. Antheridium showing differentiation of wall layer and the neck,  $\times 73$ . Fig. 4. Antheridial neck enlarged,  $\times 73$ . Fig. 5. Germinating spore with germ tube,  $\times 106$ .

the observations that empty antheridia invariably show the neck split up, suggesting that the sperms have been discharged along this canal. A neck, like the one described above, has been noticed by Black<sup>5</sup> in *Riccia frostii* but he does not comment further on it. Cavers<sup>6</sup> also figured such a neck in *Riccia glaucescens* but did not describe it.

The development of the embryo is similar to that described for other species and as observed by Srinivasan,<sup>7</sup> some of the spore mother cells degenerate during spore formation. It was also noticed that when more than four or five sporophytes are borne on the same thallus some of them degenerate, perhaps, due to lack of sufficient nourishment. Spores could be successfully germinated (Fig. 5) during the months April and May, in natural conditions and in soil solutions. Spore germination has not been previously reported in this species.

The haploid number of chromosomes is 8, one of the chromosomes being very small. This is in conformity with the previous observation of Mahabale and Gorji.<sup>8</sup>

My grateful thanks are due to Prof. L. N. Rao, at whose suggestion and under whose

guidance this work was done in the Department of Botany, Central College, Bangalore.

Birbal Sahni Inst. B. S. VENKATACHALA.  
of Palaeobotany,  
Lucknow, December 20, 1955.

1. Kashyap, S. R., *Liverworts of the Western Himalayas and the Punjab Plains*, 1929, 1.
2. Stephani, F., *Species hepaticarum*, 1900, 1.
3. Chopra, R. S., *J. Indian Bot. Soc.*, 1943, 22, 237.
4. Pande, S. K. and Ahmed, S., *Proc. Indian Sci. Congress*, 1944.
5. Black, C. A., *Ann. Bot.*, 1913, 27, 511.
6. Cavers, F., *New Phytol.*, 1911, 9, 14.
7. Srinivasan, K. S., *Madras Univ. Jour.*, 1940, 12, 59.
8. Mahabale, T. S. and Gorji, *Curr. Sci.*, 1941, 10, 82.

### EFFECTS OF TOTAL BODY X-RAY IRRADIATION ON THE LEVELS OF TRYPTOPHANE AND NICOTINIC ACID IN LIVER AND KIDNEY OF RATS

THE extreme radiosensitivity of tryptophane<sup>1,2</sup> in *in vitro* experiments, as also the dual role it has to play in the body as a constituent of a protein and as a precursor<sup>3,4</sup> of vitamin nicotinic acid prompted us to investigate the influence of the total body irradiation on the metabolism of tryptophane and its conversion to nicotinic acid. Normal metabolism of tryptophane is sufficiently well known<sup>7,8</sup> and need not be repeated here. Suffice it to say that the tryptophane first gets converted to an intermediate metabolite by the mediation of an enzyme tryptophane peroxidase<sup>5,6</sup> in presence of  $H_2O_2$ , followed by the oxidation of the intermediate to formylkynurenine.<sup>5,6</sup> Formylkynurenine is then metabolized through a number of intermediates to nicotinic acid.<sup>3,4</sup> Thomson and Mikuta's<sup>9</sup> demonstration of increased tryptophane peroxidase-oxidase activity in irradiated animals, coupled with the evidence of formation of free radicals like  $HO_2$ ,  $H_2O_2$  after irradiation might facilitate a greater conversion of tryptophane to nicotinic acid. This aspect has been studied and is being reported in this communication.

Wistar rats 2-3 months old weighing between 200-50 g. were divided into 6 groups, each group consisting of 6 animals. One group served as a control whereas the animals from other groups were sacrificed at the intervals of 2, 4, 6, 24 and 48 hours after irradiation. All animals except controls were irradiated with 250 KV Westinghouse machine using 1 mm. Al and 0.5 mm. Cu as filters at the rate of 45 r per minute. The animals were exposed to LD 50 dose of total body irradiation of 600 r each. Animals were sacrificed by dislocation of cervicle vertebrae at the intervals specified

TABLE I  
Effects of total body X-irradiation on tryptophane and nicotinic acid levels of rat tissue

Group	No. of animals	Amount of Tryptophane		Amount of Nicotinic acid	
		Liver	Kidney	Liver	Kidney
		mg./g. of tissue	mg./g. of tissue	µg./g. of tissue	µg./g. of tissue
Control	.. 6	1.961 ± 0.085	1.871 ± 0.055	126.5 ± 3.03	77.81 ± 3.02
2 hours after irradiation	.. 6	2.059 ± 0.110	1.929 ± 0.078	110.0 ± 3.99	89.75 ± 3.22
4 do	.. 6	1.717 ± 0.09	1.778 ± 0.130	121.5 ± 1.55	85.25 ± 1.10
6 do	.. 6	1.730 ± 0.038	1.797 ± 0.030	119.5 ± 1.70	93.62 ± 1.52
24 do	.. 6	1.644 ± 0.044	1.327 ± 0.028	182.4 ± 6.26	121.65 ± 2.31
48 do	.. 6	1.451 ± 0.038	1.380 ± 0.066	191.66 ± 6.28	131.66 ± 7.78

The standard errors have been calculated using the formula  $S.E. = \sqrt{\frac{\sum d^2}{n(n-1)}}$

above. Livers and kidneys were immediately dissected out, blotted free of blood and assayed for tryptophane and nicotinic acid by the procedures outlined below.

For the assay of tryptophane the homogenized tissues were refluxed with 5N NaOH for 20 hours, whereas for the assay of nicotinic acid the homogenates were autoclaved for 30 minutes at 15 lb. pressure with 1N  $\text{H}_2\text{SO}_4$ . In both the cases the hydrolysates were adjusted to pH 4.5 and stored in refrigerator (4° C.) under a layer of toluene until assayed by microbiological methods. The microbiological assay of nicotinic acid was carried out with *L. arabinosus* 17/5 by a procedure essentially the same as described by Barton-Wright.<sup>10</sup> Tryptophane was estimated by using the same organism according to the method of Barton-Wright.<sup>11</sup>

The results of tryptophane and nicotinic acid levels in livers and kidneys at different intervals of time after irradiation are given in Table I.

It will be seen from the table that the tryptophane and nicotinic acid levels do not seem to vary very significantly from that of normal control animals at 2, 4 and 6 hours after irradiation. However, the effects become pronounced at 24 hours and 48 hours, there being a diminution in tryptophane levels to the extent of 16 and 26% in the livers, and 29 and 26% in the kidneys. Concurrently there is a 45 and 58% increase in the nicotinic acid levels in the livers at 24 and 48 hour groups respectively. The nicotinic acid levels in kidneys are comparatively high and range from 54 and 69% at these intervals respectively. It has been noticed, however, that there is no definite ratio between the decrease in tryptophane and increase in nicotinic acid in both liver and kidney, and this may be attributed to the radiolability of tryptophane, and to the possible existence of different pathways of tryptophane catabolism. It is

premature at this stage to implicate the significance of higher levels of nicotinic acid in irradiated animals, but it would be pertinent to point out that the excess of nicotinic acid has been known to immobilise available methyl groups in the formation of N-methyl derivatives and thus induce fatty livers.<sup>12,13</sup> The demonstration of fatty livers in irradiated rats, which has been reported by earlier works<sup>14,15</sup> assumes greater significance in the light of our own observation on the decrease of methionine and choline levels in such animals.<sup>16</sup>

Further work in this line is in progress.

MISS SHANTOO U. GURNANI.  
U. S. KUMTA.  
M. B. SAHASRABUDHE.

Biology Division,  
Indian Cancer Res. Centre,  
Bombay-12,  
November 24, 1955.

1. Proctor, B. E. and Bhatia, D. S., *Biochem. J.*, 1952, **53**, 1.
2. Stein, G. and Weiss, J., *J. Chem. Soc.*, 1949, 3256.
3. Krehl, W. A., Sarma, P. S., Teply, L. J. and Elvehjem, C. A., *J. Nutrition*, 1946, **31**, 85.
4. Sarett, H. P., *J. Biol. Chem.*, 1950, **182**, 659, 691, 671.
5. Mehler, A. H., Knox, W. E., *Ibid.*, 1950, **187**, 431.
6. Knox, W. E. and Mehler, A. H., *Ibid.*, 1950, **187**, 419.
7. Dalgliesh, C. E., *Quart. Rev. London* 1951, **5**, 227.
8. Heidelberger, C., Gulberg, M. E., Morgan, A. F. and Lepkovsky, S., *J. Biol. Chem.*, 1949, **179**, 143.
9. Thomson, J. F. and Mikuta, E. T., *Pro. Soc. Expt. Biol. and Med.*, 1954, **85**, 29.
10. Barton-Wright, E. C., *Biochem. J.*, 1944, **38**, 314.
11. —, *Microbiological Assay of Vitamin B Complex and Amino Acids*, Sir Isaac Pitman Publications, London, 1952.
12. Handler, P., *J. Biol. Chem.*, 1944, **154**, 203.
13. —, and Dann, W. J., *Ibid.*, 1942, **146**, 357.
14. Ellinger, F., *Radiology*, 1945, **44**, 241.
15. Pohle, E., and Bunting, C. H., *Acta Radiologica*, 1932, **13**, 117.
16. Kumta, U. S., Gurnani, S. U. and Sahasrabudhe, M. B., *Curr. Sci.*, 1955, **24**, 362.



# OCURRENCE OF *CORYNEBACTERIUM* *RENALE* IN GOATS

A SPECIFIC cystitis and pyelonephritis of cattle due to *C. renale* is reported to be fairly prevalent in Europe and America. In India also, the diptheroid has been isolated recently from a case of pyelonephritis in a cow and from a large number of urine samples collected from cases of bovine hæmaturia.<sup>1,2</sup> The organism has also been recovered in several countries from the purulent infections of the urinary tract of sheep, horses, swine and dogs, but no record of its isolation from goats has been found in available literature.

The object of this note is to record the occurrence in goats of a *Corynebacterium* indistinguishable from *C. renale* in its morphological, cultural, biochemical and pathological characters. For the first time, *C. renale* was isolated during routine bacteriological examination of kidneys collected from a case of bilateral pyæmic nephritis. This led us to investigate the carrier rate, if any, of this diptheroid in goats and the role it might play in the pathogenesis of the infections of the urinary tract.

Bacteriological examination was carried out on 50 samples of urine collected from a flock of apparently healthy goats and also on kidneys of 25 goats slaughtered at Mukteswar for meat purposes. *C. renale* could be isolated from two samples of urine as well as from the pyelus of the kidneys of two of the slaughtered goats. On histological examination, all the four kidneys showed normal appearance.

Although *C. renale* has been recognized to be responsible for conditions like pyelonephritis, cystitis, etc., in cattle, the exact role of this diptheroid in the pathogenesis of such conditions is not clearly understood. This organism has been isolated not only from diseased cattle, but also from a large number of apparently healthy animals. Jones and Little<sup>3</sup> recorded its isolation from the mucous membrane of the vagina of a healthy calf. Lovell<sup>4</sup> recovered it from the urine of a cow which appeared normal but was in a herd in which pyelonephritis was known to occur. Morgan *et al.*<sup>5</sup> and Ruebke<sup>6</sup> described its occurrence in the normal male genitalia of cattle. Weitz<sup>7</sup> found that this organism was a frequent and possibly a normal inhabitant of the posterior urinary tract of apparently healthy dairy cows. Morse<sup>8</sup> could isolate *C. renale* from the urine of 17.6% of 523 apparently normal dairy cattle. In our present studies also, *C. renale* has been recovered from a case of pyæmic nephritis in a goat as well as from the urine sam-

ples and the kidneys of healthy goats. These findings may help to solve the enigma of the pathogenesis of specific types of pyelonephritis, cystitis, etc., not only in cattle but also in other species of animals.

Division of Pathology & Bacteriology,  
Ind. Vet. Res. Inst., Mukteswar-Kumaon,  
November 24, 1955.

M. R. DHANDA.

P. CHANDRA SEKARIAH.

J. M. LALL.

R. N. SETH.

1. Nandi, S. N., *Brit. Vet. J.*, 1954, **110**, 354.
2. Dhanda, M. R. and Das, M. S., *Ind. Vet. J.*, 1955, **31**, 353.
3. Jones, F. S. and Little, R. B., *J. Exp. Med.*, 1930, **51**, 909.
4. Lovell, R., *J. Comp. Path. and Therap.*, 1946, **5**, (3), 196.
5. Morgan, B. B. *et al.*, *Mich. St. Coll. Vet.*, 1946, **6**, 68. (Cited by Merchant, I. A., *Veterinary Bacteriology and Virology*, 1950, Iowa: The Iowa State College Press).
6. Ruebke, H. J., *Bacterial Flora of Bovine Male Genitalia*. M.S. Thesis, 1950, Iowa. Cited by Merchant, I. A.
7. Weitz, B., *J. Comp. Path. and Therap.*, 1947, **57**, 191.
8. Morse, E. V., *Cornell Vet.*, 1950, **40**, 178.

## NEW SPECIES OF MARINE BACTERIA TOLERATING HIGH CONCENTRA- TIONS OF COPPER

BACTERIA as primary film formers help the attachment of larval stages of fouling organisms.<sup>1</sup> Wood<sup>2</sup> believes bacterial fouling of submerged surfaces is not great though he found quite a number of bacteria forming primary film on slides painted with mercury paints, and capable of withstanding up to 250 p.p.m. of CuSO<sub>4</sub> and 100 p.p.m. of HgCl<sub>2</sub>. Waksman<sup>3</sup> also isolated a number of "copper" bacteria from sea-water tolerating 200 mg./L of CuSO<sub>4</sub>.5 H<sub>2</sub>O. The isolation of "copper" bacteria from marine materials is therefore of interest. The original isolation was made on nutrient sea-water agar containing 250 p.p.m. of CuSO<sub>4</sub>.5 H<sub>2</sub>O. Three groups were noticed.

*Group I.*—Four cultures isolated from chanks (*Turbinella pyrum*). These were gram-negative, straight, medium-sized, non-spore-forming, actively motile, monotrichous rods. They failed to grow in fresh-water media or in milk. Acid was produced from glucose, sucrose, maltose and arabinose but not from lactose. Starch was hydrolysed, gelatin rapidly liquefied and indole produced. Nitrates were reduced to nitrites and denitrified vigorously. H<sub>2</sub>S was not produced. The culture tolerated 1,000 p.p.m. CuSO<sub>4</sub>. It is named as *Pseudomonas turbinellæ* n. sp.

**Group II.**—Three cultures from pearl oysters (*Pinctada vulgaris*). These were yellow pigmented, gram-negative, thin, straight, medium-sized, non-sporing, peritrichous rods. Growth was obtained on fresh-water media also. Acid was slowly produced from glucose, sucrose and maltose but not from lactose, arabinose, and glycerol. Starch was not hydrolysed. Gelatin was slowly liquefied, indole and  $H_2S$  not produced. Milk was peptonized slowly, becoming alkaline. Nitrates were reduced to nitrites and gas produced slowly. They tolerated upto 750 p.p.m.  $CuSO_4$ . They have been named as *Flavobacterium pinctadum* n. sp.

**Group III.**—One culture from pearl oyster. This white, viscous culture, was a gram-negative rod. The rods were motile with peritrichous flagella, medium-sized to long and non-sporing. No growth was obtained on fresh-water media or in milk. Sugars were not fermented. Starch was hydrolysed; gelatin was liquefied; indole produced;  $H_2S$  not produced. Nitrates were reduced to nitrites and denitrified slowly. It tolerated 500 to 750 p.p.m.  $CuSO_4$ , and is named *Achromobacter viscosus* n. sp.

On primary isolation, the colonies of these had a brown "copper" colour. Tolerance of 750-1,000 p.p.m. of  $CuSO_4$  is the highest recorded by any worker for bacteria. The organism from chanks is a typical marine form,<sup>1</sup> failing to grow in fresh-water media. It is quite interesting to note that the conditions necessary for development of fouling organisms,<sup>1</sup> viz., reduction of nitrates to nitrites and to nitrogen, thereby increasing the alkalinity of the medium, protection of fouling organisms from the toxic constituents such as Cu, etc., are created by these "copper" bacteria. Detailed description of these will be published elsewhere.

My thanks are due to Sri. R. Venkataraman for his keen interest and helpful suggestions and to the Director of Industries and Commerce for permission to publish this note.

Fisheries Technological Station, Kozhikode,  
A. SREENIVASAN.  
December 12, 1955.

## A NEW BACTERIAL LEAF SPOT ON *CLEOME MONOPHYLLA*

A BACTERIAL leaf-disease inciting minute, round spots on the lower surface of *Cleome monophylla* L. leaves was observed at Pimpri near Poona in August 1954. Infection first appearing as water-soaked spots becomes visible on the upper surface as pale brown, round areas surrounded by yellow halo. The necrotic spots increased in size upto 1.5 mm. and later turned dark brown with whitish centre. Similar infection spots appeared also on the siliqua. Comparative studies indicated that the pathogen inciting disease on *Cleome* is undescribed. It is presented as a new species with the name *Xanthomonas cleomei* with the technical description as follows:

Short rods; mostly single, monotrichous, rarely lophotrichous;  $0.76 \times 1.93 \mu$ ; aerobic; gram-negative; capsulated; non-spore-former; not acid-fast; colonies on potato dextrose agar plates are circular with entire margin, smooth, shining, convex with striations at the periphery only, measuring 2.0 mm. in 8 days, colour picric yellow (Ridgway); gelatin liquefied; starch hydrolysed; casein digested; milk peptonised; litmus slowly reduced; hydrogen sulphide produced from peptone; ammonia not produced from peptone; nitrate not reduced; M.R. and V.P. tests negative; acid but no gas from dextrose, maltose, sucrose, lactose; no growth in salicin, dulcitol and oxalic acid; optimum growth at  $27-31^\circ C$ ; thermal death point about  $52^\circ C$ ., pathogenic to *Cleome monophylla* L. and *Gynandropsis pentaphylla* (Horticultural variety) producing spots on leaves and siliqua; found at Pimpri near Poona.

Details will be published elsewhere.

Plant Pathological Lab., S. G. ABHYANKAR.

Agric. College, Poona, M. K. PATEL.

November 9, 1955. M. J. THIRUMALACHAR.

## EFFECT OF TEMPERATURE ON DEVELOPMENT OF MIRACIDIA OF *GIGANTOCOTYLE EXPLANATUM* (PARAMPHISTOMATIDAE: TREMATODA)

THOUGH a number of life-histories have been worked out of various digenetic trematodes in India, as well as abroad, little attention seems to have been paid to the effect of temperature on development. In the present studies, the effect of temperature on the development of miracidia of *Gigantocotyle explanatum*,<sup>1,2</sup> an

1. Zöbell, C. E., *Marine Microbiology*, Chronica Botanica Co., Waltham, Mass., 1946; *Proc. Soc. Expt. Biol. Med.*, 1933, 30, 1409; *The Collecting Net*, 1939, 14, 5.

2. Wood, E. J. F., *Austr. J. Mar. Freshw. Res.*, 1953, 4, 160.

3. Waksman, S. A., Johnstone, D. B. and Carey, C. L., *J. Mar. Res.*, 1943, 5, 136.

amphistome commonly found in the liver of cattle and buffalo, has been studied.

The eggs when kept at 82° F. hatch out into miracidia in 11-12 days and at 85° F. in 10-11 days, although the hatching continues for another 3-4 days. At 97-99° F., the eggs take only 9 days and when kept at 104° F., the eggs do not show any development and all of them die.

In another series of experiments it was found that unembryonated eggs can withstand a temperature of 50° F. for 14 days (336 hours) without any harm. Further, the period of refrigeration has no effect on subsequent development of the eggs. The unembryonated eggs however die if kept at 50° F. for 600 hours.

When fully embryonated eggs were used, it was found that the miracidia which were ready to hatch can withstand a temperature of 50° F. for 6-7 days only and if kept for 9 days and onwards, they die.

These studies seem to be specially interesting in the sense that live material or eggs only, can be packed in ice and sent almost anywhere by air and be available for life-history studies.

The experiments are being continued and a full account will be published elsewhere.

Dept. of Zoology, K. R. SURESH SINGH.  
The University, Lucknow,  
January 28, 1956.

1. Creplin, F. C. H., *Arch. f. Nat. gesch. Jahrg.*, 1847, 13, Bd. 1, 30.
2. Nasmark, K. E., *Zool. Bidr. Uppsala*, 1937, 16, 301.

### A METHOD FOR OBTAINING ALGAL CULTURES FREE FROM ASSOCIATED MICRO-ORGANISMS

DURING investigations on the microbial deterioration of cotton textiles in these laboratories, it was frequently observed that in localities characterised by heavy rainfall, algæ appear in addition to fungi and bacteria on fabrics exposed to weathering.<sup>1,2</sup> In the presence of algal growth, a fabric showed comparatively greater deterioration than in its absence.<sup>2</sup> It was therefore considered of interest to study the role of algæ in the degradation of exposed fabrics.

A prerequisite to such a study is the isolation and the culturing of algæ free from associated micro-organisms such as fungi and bacteria. Among the most important methods so far adopted for this purpose are: (i) exposure of algal cultures to ultra-violet light,<sup>3,4</sup> (ii) re-

peated transfer of growing algal cells,<sup>5,6</sup> and (iii) treatment with antibiotics.<sup>7</sup> These methods were tried, but as experienced by other workers<sup>6,8</sup> did not prove successful. The object of this note is to draw attention to a method which has been newly evolved, using mercuric chloride for the purification of the algal culture.

In the new method, the algal suspension is transferred to a Buchner funnel and filtered so as to secure a uniform deposit of the alga on the filter-paper. Small pieces (approximately 1 sq. cm. in area) of the filter-paper coated with alga are treated separately in test-tubes with aqueous mercuric chloride solutions of different concentrations (varying from 1:1,000 to 1:10,000) for periods ranging from 2-10 minutes. Pieces after treatment are repeatedly washed under aseptic conditions with sterilized water and planted in test-tubes containing separately nutrient broth and Detmer solution. They are then incubated at 28 ± 2° C. in diffused light. Sets of test-tubes showing algal growth in Detmer solution but no turbidity in corresponding nutrient broth tubes are selected and the cultures so obtained are tested for their purity by standard methods<sup>9</sup> for the presence of actinomycetes, azotobacter, anaerobic and other types of bacteria.

The above technique was recently applied by the authors to an alga isolated from cotton fabrics exposed at Bombay during 1951-52. Treatment with mercuric chloride of dilution 1:5,000 for 5 minutes effectively purified the culture of *Chlorella ellipsoidea* Gerneck free from associated micro-organisms.

Our thanks are due to Dr. M. O. P. Iyengar for the identification of the culture.

Tech. Development U. S. GUPTA.  
Estt. Lab., K. L. MAHESHWARI.  
Kanpur, January 16, 1956. S. R. SENGUPTA.

1. Zuck, R. K. and Diehl, W. W., *Am. J. Bot.*, 1946, 33, 374.
2. Technical Development Establishment Laboratories, Kanpur, Report No. Bio. 47/63, June, 1947.
3. Allison, F. E. and Morris, H. J., *Proc. Sec. Internat. Cong. Soil. Sci. III Cong.*, 1932, 24.
4. Gerloff, G. C., Fitzgerald, F. P. and Skoog, F., *Amer. J. Bot.*, 1950, 37, 216.
5. Pringsheim, E. G., *Beitr. Biol. Pfl.*, 1913, 12, 49.
6. De, P. K., *Proc. Royal Soc.*, 1939, 127B, 121.
7. Fish, G. R., *Meddland Goteborgs Bot. Tradgard.*, 1948, 18, 81.
8. Taylor, F. J., Personal communication.
9. Brunel, J., Prescott, G. W. and Tiffany, L. H., *The Culturing of Algae—A Symposium*, Charles F. Kettering Foundation, U.S.A., 1950, 27.

## REVIEWS

**The Foreseeable Future.** By Sir George Thomson. (Cambridge University Press), 1955. Pp. vii + 166. Price 10 sh. 6 d.

What will life be like, if technology as we know it today is given a chance to progress unimpeded? An answer to this interesting question is provided by Sir George Thomson in his recent book with title as above.

For purposes of presentation, Thomson assumes firstly that the world will continue to be peaceful or at least that such wars as may arise may not do vastly more damage than those of the immediate past; and secondly, that the promise of technology may never transcend what is permissible under the physical laws, which are inexorable in nature and which he terms as 'principles of impotence'. With the limits thus set, he proceeds to the consideration of the possibilities of technological advancement in regard to energy and power, materials, transport and communications, meteorology, and food, devoting to each a separate chapter. The last three chapters lie almost on the border-line he has set himself for study, and deal respectively with: some applications of biology, some social consequences, and thought—artificial and natural. The first five chapters naturally constitute the best part of the work and are the least controversial.

In regard to energy and power, Sir George is disposed to be rather generous, and assures us that there is nothing to prevent us from getting all the power we want even if the supply of coal and oil should fail. He observes that in the not distant future the nuclear reactions which produce the energy of the hydrogen bomb will have been tamed, and we may fairly assume that electrical energy can continue to be produced in any quantities we want, and at a price not exceeding that at which it is available today.

It is only to be expected that with our ability to make materials with much higher breaking stresses than at present available, engineering structures as well as architecture will have been profoundly modified. We may expect that improved materials will allow many kinds of design to be made which are much lighter and more flexible.

In the field of transport and communications, Thomson's expectations are relatively modest. According to him, there would be no object in

travelling to Australia with half the speed of light, if it took half-an-hour to buy the ticket and book the luggage! Four or five times the speed of sound is all that may be worthwhile to achieve, and we are not so far away from this even now. He also provides a delightful picture of decentralisation by televising the telephone, and the putting over of business deals by a group of people who have never 'met' in the real sense, but only seen each other on television screens! He is enthusiastic enough about interplanetary travel in spite of the real dangers from meteorites, and is confident that in the next 50 or 100 years the ingenuity of engineers will have overcome such and similar obstacles.

Meteorology bristles with many imponderables, but Sir George is hopeful that climatic changes can be induced either through the medium of artificial rain or by the breeding of plants specially suitable for the reclamation of deserts and arid regions. In regard to food he observes that more will have to be made by the chemist and the bacteriologist in the future than what the farmer can grow, and it ought to be possible to allow much of England to return to parkland and to let the downs go back to grass.

The 'foreseeable future' becomes less distinct if also more exciting as Sir George proceeds to consider, in the next three chapters, the possibilities of improving the species by controlled gene mutation by biologists, domestication of the monkey for doing the kind of work that is now being done by 'unskilled labour' (in India this would approximate to more than 70%), replacement by mechanisation of what is mostly done by human beings, no doubt with a great deal of drudgery, and many similar issues.

A detailed consideration of these chapters will take us far out afield, but it will suffice to say that these chapters raise far more issues than they seem to solve. For example, the process of mechanisation as thoroughgoing as envisaged will have done out of office nearly 90% of humanity. This raises the question which he himself asks, "What will our descendants do with the stupider people in their new world? Engineers, artists, teachers, scientists, administrators, even salesmen have a place and a good place, but these posts are not for the stupid men."

Likewise, there is a great deal more to be said about 'values', which, as Sir George observes, will be more or less obliterated under a scheme of mechanisation. Perhaps the one to one correspondence he has tacitly assumed between brain and mind may not be true, as he himself admits. The evidence for it is very partial and indirect, and it may be the case that when man has mastered the intricacies of the brain there will still remain the fields of the mind and the soul to make art, religion, patriotism and love as meaningful as before.

One may hold different views from Thomson in regard to these matters, but it is impossible to deny that here is a book which is as thought-provoking as it is eminently readable.

---

*Progress in Nuclear Physics*, Vol. IV. Edited by O. R. Frisch. (Pergamon Press, London), 1955. Pp. vii + 379. Price 70 sh.

The fourth volume of this series presents the usual "mixed fare", each article in it being a summary of the recent advances in a particular aspect of nuclear physics. Of the nine articles, four deal with experimental results and three with actual experimental technique, and two represent quasi-theoretical accounts relating to nuclear phenomena.

With the rapid development in high energy accelerators, a large mass of experimental data on nuclear collisions has been obtained which has to be sifted and classified before the mathematical physicist is asked to 'explain' them. The first chapter on photo-disintegration of nuclei relates to a phenomenon first demonstrated by Chadwick and Golhaber. It is to be expected that photo-disintegration should be less complex than nucleon-nucleus collisions since the "bombarding" particles are photons. However, the complex character of the charge current vector inside the nucleus presents mathematical difficulties which have no parallel in quantum electrodynamics. It is hoped that experimental work may reveal new physical details which may assist the physicist in working out a more satisfactory theory of nuclear forces. Titterton not only summarises experimental results and techniques but also gives a brief description of the theoretical models as that of Goldhaber and Teller, Levinger and Bethe employed to explain the "giant resonances" in the cross-sections.

Accelerators have made possible the production of heavy ions of high energy whose behaviour, range energy relations and reactions with

nuclei have been studied in detail in nuclear emulsions. A clear account is given by Walker in a brief article which is followed by Newton's survey on 'Nuclear properties of very high elements', i.e., those above the double closed shell which is completed at  $\text{Pb}_{82}^{208}$ . A brief resumé of the general theoretical considerations based on the liquid drop and the unified nuclear models is given.

The chapter on 'Neutron Spectroscopy' by D. J. Hughes deals with the recent advances in a subject whose aim in nuclear physics is similar to that of optical spectroscopy in atomic phenomena. Excitation of the levels by nuclear interactions as well as the decay by emission of particles and photons can be used to study the spacing of the energy levels, the transition probabilities and their relation to the spins and parities of the particles comprising nucleus. In the section on the determination of level parameters, the general trends in establishing the relevance of these parameters to modern nucleon theory are pointed out.

The three articles on actual experimental techniques are: (i) Scintillation spectrometers, by Breitenberger, (ii) Focussing in high energy accelerates, by Pickavance, and (iii) The preparation and chemistry of the transuranic elements, by McKay and Milstead. Breitenberger, besides describing the mechanism of the spectrometer, presents clearly the statistical features of the problem in view of the random nature of the processes involved, the initiation, the photon transfer, the secondary electron cascade, the interruptions to it, the duration of the electron pulse and "after effects". As the editor has observed, the article by McKay and Milstead does not belong to the domain of physics but has been included in view of their recently realised importance to nuclear physics.

Pickavance gives a very neat summary on the two kinds of focussing, phase and directional, in the various types of accelerators, both cyclic and linear.

To describe a "mathematical theory" in any other language than mathematics is a contradiction in terms. Yet such a description is welcome since the mathematical apparatus necessary for a detailed understanding of meson physics is so complex that a physicist even with a "reasonable knowledge" of mathematical techniques finds it difficult to follow the derivation of the results. Dalitz's discussion on the theoretical interpretation of meson-work based on the Tamm-Dancoff method can be appreciated only by one who is well nucleon scattering where he refers to the recent

acquainted with the original work. It is to such a group that this article is intended.

An article on isotopic spin and nuclear reactions by Burcham is written in a similar style. The concept of isotopic spin was introduced to impose a new type of constraint or selection rule among nuclear energy levels—a concept forced by the acceptance of the principle of charge independence of nuclear forces.

The volume justifies its avowed aim of taking stock in nuclear physics, a task undertaken by the concerted attempt by nine experts in the fields. The task is rendered difficult by the rapid shift of the scene of meson theory under the compulsion of new and surprising experimental findings.

A. RAMAKRISHNAN.

**Assay Methods of Antibiotics.** (A Laboratory Manual). By Donald C. Grove and William A. Randall. (Medical Encyclopædia Inc., 30 East 60th Street, New York. Distributors outside U.S.A.: Interscience Publishers, New York, London.) Pp. xxvi + 238. Price \$5.00.

This is the best and most comprehensive laboratory manual the reviewer has come across on the subject, and it is bound to be of great value to students, laboratory workers, and clinical pathologists. The methods given are those actually employed by the Food and Drug Administration, Washington. The methods of assay for each of the antibiotics are given not only for the crystalline products but also for all the pharmaceutical dosage forms, combination of antibiotics, body fluids, and animal feeds. The following seventeen antibiotics have been covered: penicillin, streptomycin and dihydrostreptomycin, three tetracyclines, chloramphenicol, bacitracin, tyrothricin, polymyxin, neomycin, erythromycin, carbomycin, viomycin, fumagallin, mystatin and anisomycin. Very useful are also the chapters on the identification of the antibiotics, tests for toxicity, pyrogens and sterility, methods of determining the sensitivity, miscellaneous tests, the physical properties, and details of the culture media, solutions, reagents and equipment required. There is no need to turn to any other literature source to carry out the assays of antibiotics now in use in any type of material. The reviewer feels that the unfortunate misprint of "sodium nitrate" for "sodium nitrite" occurring on pages 25 and 26 had not been there at all in such a very valuable manual. The short foreword of the Editors is philosophical and fascinating. The get-up of the

book is good enough to stand the tremendous thumbing and turning over of the pages it is bound to receive.

K. GANAPATHI.

**Hydrogen Ions, Vol. I. Fourth Edition.** By Hubert T. S. Britton. (Chapman & Hall), 1955. Pp. 476. Price 70 sh.

This is the fourth edition of Dr. Britton's book which is well known. The matter has been revised and enlarged in keeping with the post-war developments and the importance of hydrogen-ion concentration measurements in pure and applied chemistry.

The volume consists of 21 chapters. Beginning with the theory of electrometric methods and standard half-elements, the various types of electrodes, together with their limitations, are dealt with in Chapters 3 to 7. Considerable space has been rightly devoted to the glass electrode. Although there are books on this electrode, a concise description of this type is most welcome. The next seven chapters cover E.M.F. measurement, modified potentiometric and other methods, volumetric analysis, abnormal acids, ionisation of dibasic and polybasic acids, and activity theory of solutions. Chapter 15 provides a good outline of the work on which the standardisation of the pH scale is based. The last six chapters deal with the Lowry-Brönsted theory, solutions of known pH, indicator methods and their limitations. There is a useful appendix to calculate pH values from electrode potentials.

The volume is well illustrated with tables and figures, and ends with an author and subject index. Each chapter includes important references. The subject-matter has been ably and concisely presented. The price is perhaps a bit high. This monograph is a valuable contribution in the field of chemistry and can be safely recommended to the research worker, the student of chemistry and the industrial chemist.

T. L. RAMA CHAR.

**Particle Size Determination.** By R. D. Cadle. (Interscience Publishers), 1955. Pp. xv + 303. Price not given.

The volume under review is the seventh of a series of manuals intended by the publishers to provide straightforward description of laboratory procedures and methods for the evaluation and recording of experimental results. Their objective may be said to have been fully realised in this volume.

The determination of particle size is a vast field and much work has been and is being

carried out on the subject. As a result, a large number of methods is available, and these have been classified into those depending on optical microscopy, electron microscopy, sieve analysis, sedimentation and elutriation, surface area measurements, optical methods and miscellaneous methods. The theoretical basis for each method has been described along with the basic equations. The theoretical as well as the practical limitations of the methods are also indicated. Each of these sections contains a list of references which enhance the value of the work.

Before the actual descriptions of the various methods are given, the methods of sampling, treatment and presentation of data obtained and the selection of the appropriate method of particle size determination are clearly dealt with.

To the scientist or the engineer faced with the task of determining the sizes of particles, this book will serve as a valuable reference work, and it will undoubtedly be a very useful addition to every scientific and technical library.

M. G. SUBBA RAU.

**Principles and Practice of Field Experimentation.** Second Edition. (Technical Communication 18.) By John Wishart and H. G. Sanders. (Commonwealth Bureau of Plant Breeding and Genetics, Cambridge), 1955. Pp. 133. Price 21 sh.

This is a revised edition of an earlier publication by the same authors issued by the Empire Cotton Growing Corporation. The present edition, like the earlier one, is divided into two parts, the first dealing with the principles of experimental design and the second with the practical considerations in the conduct of field experiments. There are 17 chapters in all. While Part II is very much the same as in the earlier edition, Part I has been amplified by the addition of two chapters on confounding and experiments with large number of varieties, and by the insertion of some fresh explanatory material in the text.

The publication has the merit of simplicity, which is important for a large class of readers, and emphasises practical matters that should engage the attention of the experimenter, in addition to the statistical aspects. This former part is frequently omitted from purely statistical text-books. The practical experimenter should find the manual a useful addition to his resources, as it would help him to design simple as well as factorial experiments

in randomised block, latin square and split plot designs, and to analyse their results. He would also be introduced to the idea of confounding and incomplete block arrangements for testing a large number of varieties.

As points of criticism, one would like to see a clearer explanation of the nature of experimental error than is contained in the brief section on statistical ideas at the beginning of Chapter I. The definition of partial confounding, given on page 62, does not appear to be correct. The term, as generally understood, signifies confounding of given degrees of freedom in only a part of the experiment, so that information on these degrees of freedom is available from the other part. In the present manual the term is used in the sense that a fraction of the degrees of freedom assigned to some interaction is confounded leaving the remaining component of that interaction unconfounded. Two symbols  $\nu$  and  $n$  are used for degrees of freedom and might cause confusion. In the second part, a chapter is devoted to observation plots. The emphasis placed on carrying such plots side by side with experiments proper appears to be excessive. The right procedure even for testing characters like lodging or quality is to conduct the experiment under normal conditions of cultivation. Even in plant breeding, where very small plots with a few regularly spaced plants are unavoidable initially, a practice adopted successfully in India is to try bulks of the more promising progenies in experiments with larger plots, the seed being sown with the common seed-drill.

These are, however, minor points and there is no doubt that the authors and the publishers have rendered a very useful service to the agricultural experimenter by bringing out the present manual.

V. G. PANSE.

**Ancient India (Special Jubilee Number, No. 9.)** (Published by the Director-General of Archaeology of India, New Delhi), 1953. Pp. 233. Price Rs. 17.

The Special Jubilee Number of *Ancient India* is issued in commemoration of the completion of the 50th year of the Archaeological Survey of India as a Central Organisation. Appropriately, the ten sections of this attractive tome review the progress achieved by the various branches of the Archaeological Department. Contributed by official specialists, the articles are all at once factual and authoritative. However, they all seem to fall into set grooves. It would have been desirable perhaps to have

included some contributions from experts who are free from the trammels of official routine.

To say this is not to underrate the value of the contributions presented in this Special Number. In spite of this, the volume furnishes a vivid picture of the main facts of the Department's archæological activities which comprise survey, exploration, excavation, preservation of monuments, epigraphical research and development of museums. Doubtless, commendable progress has been made, thanks to the vision and capacity of stalwarts like Cunningham, Burgess, Marshall and Wheeler.

There are however several directions in which the lapses of the past have to be rectified. A co-ordinated policy of excavation of all potential sites, including those in South India which suffered neglect till 1945, an up-to-date scheme for preserving all the pre-historic and proto-historic sites on the lines adopted in Great Britain, provision of suitable accommodation and well-lit galleries in museums and a determined effort to speed up the publication of the collected inscriptions are but a few of the urgent needs, admitted by the officials themselves. The obstacles are no doubt formidable, but it is the duty of a culture-state to overcome them all. The Jubilee Number contains 122 plates of archæological interest, all excellently reproduced. The get-up of the sumptuous volume is splendid.

K. K. PILLAY.

(i) *Cestodes of Whales and Dolphins from the Discovery Collections.* By S. Markowski. (*Discovery Reports*, Vol. XXVII.) (Cambridge University Press), 1955. Pp. 377-95. Price 12 sh. 6 d. (ii) *Mysidacea.* By O. S. Tattersall. (*Discovery Reports*, Vol. XXVIII), 1955. Pp. 1-190. Price 65 sh.

(i) Eighty-eight samples of adult cestodes and encysted larval stages were collected from the intestines and blubber respectively of seventy-three whales and seven dolphins caught off South Africa and different positions in the Southern oceans. Two larval stages are described and the adults are identified to belong to seven Tetrabothriid species belonging to the three genera *Tetra bothrius*, *Trigonocotyle* and *Priapocephalus* and to the eight species, *Diplogonophorus balænopterae*. The author has drawn attention to the specific differences being found in the testes, the eggs, the embryos and the longitudinal muscles of mature segments. A discussion of the absence of host specificity among the parasites studied, make this report of general interest.

(ii) The author has examined over 5,000 specimens collected from 391 stations in the South Atlantic and Southern oceans and has shed considerable light on the classification of the mysids which not only continue to grow long after sexual maturity, but acquire new features of appendages. By examining larger numbers of specimens of all sizes, she has elucidated the true identity of younger individuals of species of *Gnathophausia* and *Eucopeia*, and has more or less defined the limits of variation within different species, enabling easy identification of any mysid specimen. A total of 36 genera and 95 species are described from not only the *Discovery Collections*, I and II, but also that made by R. R. S. "William Scoresby".

This report has also extended our knowledge of the geographical distribution of many mysid species. That there is no evidence of bipolarity and that the many species recorded from the Northern and Southern Hemispheres may be continuous at deeper levels of ocean, are important conclusions. The author has had the student of taxonomy in mind whom she has undoubtedly helped with a large number of useful figures, tabulated comparisons and lists of species and localities.

Both these issues will be useful additions to libraries.

C. P. GNANAMUTHU.

#### Books Received

- Fundamentals of Electroacoustics.* By F. A. Fischer. (Interscience Publishers), 1955. Pp. ix + 186. Price \$6.00.
- Treatise on Inorganic Chemistry*, Vol. I. By H. Remy. (Elseviers), 1956. Pp. xv + 866. Price £ 5.35.
- Statistical Methods for Agricultural Workers.* By V. G. Panse and P. V. Sukhatme. (Indian Council of Agricultural Research, New Delhi), 1956. Pp. xvi + 361. Price Rs. 15.
- Structure Reports for 1942-44*, Vol. 9. Edited by A. J. C. Wilson. (N. V. S. Oosthoek's Uitgevers, MIJ, Utrecht), 1955. Pp. viii + 448. Price Dfl. 65.
- Buyers' Guide to European Machinery.* (The Organisation for European Economic Co-operation, Paris), 1955. Pp. 46. Price 3 sh. 6 d.
- A Colored Atlas of Some Vertebrates from Ceylon Serpentine Reptilia*, Vol. 3. By P. E. P. Deraniyagala. (Ceylon National Museum), 1955. Pp. xviii + 121. Price not given.
- The Dynamics of Living Protoplasm.* By L. V. Heilbrunn. (Academic Press), 1956. Pp. vii + 327. Price \$6.50.



---

## SCIENCE NOTES AND NEWS

---

### Comparative Flower Weight in Common Jasmines

Shri G. S. Bhatnagar, National Botanic Gardens, Lucknow, observes as follows:

The average flower weight in common jasmines has been the least utilized of all characters to distinguish between the various species of the same genus and the different varieties in the same species. This may be inferred from the average number of flowers in a kg. weight given in the following: *Jasminum Sambac*: Mungra, 400; Rai Bela, 1,600; Motia, 2,000; Desi Bela 4,000; *J. pubescens*: Giant, 4,600; Violet (7 sepals), 6,000; Kund, 7,500; *J. rigidum*, 8,000; *J. arborescens* (Niwari), 10,000; *J. sambac* (single), Hazara Bela, 10,000; *J. grandiflorum* (Chameli), 13,000; *J. flexile*, 13,000; *J. pubescens* (Violet), 5 sepals, 15,600; *J. auriculatum* (Juhi), 20,000.

### Making Atoms Visible

The atomic structure of a surface may be seen clearly in the latest model of the field ion microscope, developed by Erwin Muller, Professor of Physics at Pennsylvania State University. Hitherto, the instrument could present only blurred picture of some large-sized atoms widely scattered over the surface, but now all the atoms are clearly visible. The microscope operates with a field strength of 5 million volts per centimetre. Built entirely of glass, it contains sealed-in wires used to apply up to 30,000 volts.

The instrument resembles two thermos bottles, one inside the other. Low temperatures of the order provided by liquid air are necessary for good microscope resolution. Within the vacuum is a fine tungsten wire, its tip coated with the substance to be studied. The surface of the tip is shown on a fluorescent screen. Helium is used to make the ions, which in turn produce the image on the fluorescent screen.

### Multi-Purpose Particle Accelerator

A new 3-million-volt Van de Graaf particle accelerator, which will serve as a powerful and versatile machine radiation source has been announced by the High Voltage Engineering Corporation, Cambridge, Mass.

The 9-ton supervoltage generator is designed to produce nearly all the fundamental radiations—electrons, X-rays, positive ions or neu-

trons. Conversion of the machine from production of one type of radiation to another is a relatively simple step, achieved through use of appropriate components manufactured by High Voltage. For example, the accelerator can be shifted from electron processing to X-ray production by replacing the beam scanner of the machine with a special heavy metal target 1" in diameter and 1/8" thick.

The new machine has a power output rating of 3,000 watts of radiation at 3-million volts. It is claimed that this unit will produce a radiation field several hundred times more intense than the most powerful radioactive cobalt source now in industrial use.

### New Transistor for Very High Frequencies

Performance of the original junction transistor, announced by Bell Laboratories in 1948, was limited to lower frequency ranges. This earlier basic device is a three-layer "sandwich" of germanium sealed in a metal can a fraction of an inch in diameter. The outside layers are of *n*-type (negative) germanium; the central layer is of *p*-type (positive) germanium. Wire leads connect to each of the three layers and extend outside the can.

The more recent experimental device, known as the junction tetrode transistor, has been made to perform at very high frequencies by reducing the width of the germanium bar and the central *p*-layer, and by adding a fourth electrode. New techniques for producing the thin middle layer have recently made possible an almost ten-fold reduction in its width. In the billion-cycle transistors, this layer is less than two ten-thousands of an inch wide.

Telephone engineers are especially interested in broadband devices, such as the junction tetrode transistor, which enable hundreds of telephone conversations to be carried over a single pair of wires at one time. Until now this job has been done exclusively by vacuum tubes.

### Silicon Power Rectifier

A tiny new electronic device made of extremely pure silicon has been announced by Bell Telephone Laboratories recently. An efficiency of more than 98% of the theoretical limit is claimed for the device. Two of the new rectifiers, when made about the size of

peas, linked together, and mounted on a cooling fin, will furnish more than 20 amp. D.C. at 100 volts. This amounts to 2,000 watts—with only 20 watts lost through heat. The new silicon rectifiers provide 5,000 times more current than conventional rectifiers of the same size, thus permitting miniature operating units.

#### Use of Waste Heat from Nuclear Reactors

Waste heat generated by nuclear reactors is being used for large-scale space heating at the Atomic Energy Commission's Hanford Plant, U.S.A. The heat is obtained from coolant waters and is being used as follows: the coolant water is pumped to a heat exchanger, where it gives up its heat to an ethylene glycol water solution, which in turn transmits the heat to air-conditioning systems in various Hanford buildings. The reactor coolant is held until its radioactivity level has decreased to a point where it can safely be discharged into the river.

#### Mixed Nitrogen-Phosphorus Fertilizer

A mixed nitrogen-phosphorus fertilizer prepared from phosphate rock and using hydrochloric acid and ammonium sulphate is reported by Gadre and Gupta in the *Journal of Scientific and Industrial Research* (1956, 15 A, 84). The product is a free-flowing powder containing 15%  $P_2O_5$  (90% of which is citrate-soluble) and 7.4% nitrogen as ammonium chloride. The fertilizer value of the product has been assessed by the Indian Agricultural Research Institute, New Delhi, and it has been found to be superior to ammonium sulphate and 'superphosphate alone' treatments, but is slightly inferior to an equivalent mixture of ammonium sulphate and superphosphate.

#### Tritium Estimation in Water Samples

A new method for measuring the concentration of tritium in water samples, is reported by J. F. Cameron in a recent issue of *Nature* (1956, 176, 1,264). The method, which is both simple and rapid, consists of introducing the tritium in the form of water vapour as part of the filling of an internal gas counter. Any tritium atoms disintegrating inside the sensitive volume of the counter give rise to counts, and from the observed count-rate the number of tritium atoms present is evaluated. The normal working pressure of the vacuum apparatus is 1 micron, which can easily be obtained with a single-stage rotary vacuum pump and a liquid-nitrogen trap.

#### Banana Wilt Disease

In recent investigations, in Jamaica, of Panama disease or vascular wilt disease of bananas (*Fusarium oxysporum* f. *cubense*), J. Rishbeth has confirmed earlier findings on the mode and progress of infection and has contributed some new and interesting information on this important disease and on the biology of its causal organism (*Ann. Bot.*, 1955, N.S. 19, No. 75, 293). The pathogen has proved difficult to isolate from soil by plating, but it can be detected in soil by using a suitable host. Thus when small bananas were grown in pots under appropriate conditions, pathogenic isolates of *F. oxysporum* produced rhizome infections, whereas other isolates did not. When *F. oxysporum* isolates were obtained by plating from various sources, the proportions which proved to be pathogenic were: 91% from the rhizome of pseudostem of plants showing typical wilt; 29% from variously affected roots; and none from soil. The information now available suggests that the banana pathogen, like other parasitic forms of *F. oxysporum*, has a limited host range; however, it has now been shown to cause a limited root infection of *Heliconia psittacorum* and may possibly originate on species such as this related to the banana. An account is also given in the paper of the development of the disease in sites which had been replanted after previous infection and abandonment.

#### Asian Wild Life Conservation

Based on the findings of a recent study tour of 30 countries in the Middle East and South and South-East Asia, Lee M. Talbot, of the University of California, has made the following proposals to the International Union for the Protection of Nature to meet the immediate needs for preservation of threatened species and for general wild life conservation: (i) The publication of an illustrated children's text-book giving a simplified introduction to conservation so as to educate and stimulate wide general interest; (ii) The appointment of a wild life adviser who would be available to governments that request his services to fulfil the immediate need for a technical approach to the problems of wild life and the establishment of park areas; (iii) The establishment of a programme to assist the authorities in these countries to set up their own wild life technician training organizations; (iv) The conduct of ecological studies of the principal animal species in order to obtain the necessary data

on which to base effective management programmes.

Persons interested in the work of the IUPN are encouraged to write to the Secretary-General at the Union's new address: 31 Rue Vautier, Brussels, Belgium.

#### Relative Merits of Soil Conditioners

With the aid of a new test for measuring the cohesive strength of wet soil crumbs, W. W. Emerson, of Rothamsted Experimental Station, has compared the performance of several materials offered for stabilising soil granules against rain and thus improving aeration and preventing erosion and "capping".

It was noted that whereas the samples treated with polyvinyl acetate remained unchanged in size, those treated with carboxylated polymers swelled considerably. It was inferred that soil conditioners fall into two groups according to the nature of the molecular linkage—interlamellar in the case of the vinyls and dextran, and edge-linkage with the carboxylated polymers. Greater efficiency of the latter type of alginate also failed in acid soils, the cause being attributed to precipitation as calcium alginate (*J. Agric. Sci.*, Feb., 1956).

#### Institution of Chemists (India)—Associateship Examination, 1956

The Sixth Associateship Examination of the Institution of Chemists (India), will be held in November 1956. The last date for receiving applications from intending candidates is 31st July 1956. The Examination in Group A (Analytical Chemistry) is divided into the following nine sections and the candidates will be examined in any two of them according to their choice, in addition to General Chemistry including Organic, Inorganic, Physical and Applied Analytical Chemistry: (1) Analysis of Minerals, Silicates, Ores and Alloys; (2) Analysis of Drugs and Pharmaceuticals; (3) Analysis of Foods; (4) Analysis of Water and Sewage; (5) Biochemical Analysis; (6) Analysis of Oils, Fats and Soaps; (7) Fuel and Gas Analysis; (8) Analysis of Soils and Fertilisers; and (9) Analysis Connected with Forensic Chemistry.

Candidates registering their names as examinees by the 31st May 1956, will be entitled to avail of the tutorial classes.

Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

#### XIV International Dairy Congress

The Government of India is participating in the Fourteenth International Dairy Congress, which is scheduled to be held at Rome during the last week of September 1956. The topics for discussion at the Section Meetings and at the Conference have been selected with a view to focuss attention on the problems of milk production, manufacture of milk products and consumption of dairy products in various parts of the world, and the developmental programmes undertaken for increasing milk consumption, particularly in underdeveloped areas. On this occasion, the Organising Committee of the Congress intend publishing an International Dairy Index-Book containing particulars about important dairy research and educational centres, official and private dairy organisations, dairy manufacturers and dealers of dairy machinery and equipment in different countries. Dr. K. C. Sen, Director of Dairy Research, Government of India, Ministry of Food and Agriculture, New Delhi, has been appointed as the Liaison Officer for the International Dairy Congress in India.

#### Award of Research Degree

The Gujarat University has awarded the Degree of Ph.D. to Shri S. V. Venkateswaran for his thesis entitled "Studies in Meteorology".

The University of Rajputana has awarded the Degree of Ph.D. to the following for theses indicated against each: Sri. Vinayak Laxman Talekar—"Studies of Rectification in a Gas (Nitrogen) Discharge and Other Published Work"; Sri. Gopichand Patni—"Contributions to the Study of Ballistics"; Sri. Kuthoor Sundaresa Srinivas—"Studies in Synthetic Antimalarials".

The University of Calcutta has awarded the Ph.D. Degree in Biochemistry to Shri M. L. Sen Gupta for his thesis entitled: "Treatment of Groundnut Oil with Clays and Its Chromatographic Separation on Alumina".

# Current Science



Vol. XXV]

APRIL 1956

[No. 4

	PAGE		PAGE
<i>Training and Research in Applied Mathematics</i> .. ..	103	<i>Letters to the Editor</i> .. ..	111
<i>Electronic Computers in Scientific Research</i> .. ..	104	<i>Release of Energy from the Atmosphere at High Altitudes</i> .. ..	130
<i>Treatment of Infectious Hepatitis</i> ..	105	<i>Reviews</i> .. ..	131
<i>The Embryology of Angiosperms, A Retrospect and Prospect—P. MAHESHWARI</i> .. ..	106	<i>Applied Biology—N. L. DUTT</i> ..	136
		<i>Science Notes and News</i> .. ..	137

## TRAINING AND RESEARCH IN APPLIED MATHEMATICS

WHILE the role of mathematics as the Queen of the Sciences is easily conceded and very well understood, there is a great deal of confusion in the minds of many workers regarding the role played by applied mathematics in science and engineering. Applied mathematics is fast emerging as a separate discipline, with its own characteristic approach to various problems, quite distinct from the methods of pure mathematics. It is high time that courses of study are offered in our Universities, at least at the post-graduate level, where some directed study may be made of the applied aspect of mathematics in physical, technical and biological sciences. An obvious corollary to this is the need for establishing one or more computatorial centres, where modern high speed calculating machines would be developed and could be utilised by workers in applied mathematics. In this connection the following memorandum prepared by Prof. B. R. Seth and circulated amongst the members who attended the South Asian Conference on Mathe-

matical Education held in Bombay recently deserves careful study.

Mathematics is applied if conceived in a spirit of ready co-operation with other sciences in the great endeavour of comprehending our environment, and of bringing order and scientific basis into this study. It should be original and imaginative in the invention and use of its concepts. Unlike pure mathematics it shows in its conceptual activity a deep interest in the world of outer experience and enriches mathematics with structures closely related to or suggested by experience and observation. In this respect Indian Mathematics has so far failed to make a signal contribution.

The following developments have revolutionized the concept of applied mathematics: (i) Axiomatic approach; (ii) Uncertainty principle as illustrated in statistical mechanics, quantum mechanics and modern bio- and sociological phenomena; (iii) Industrial competition and military rivalry; (iv) High speed electronic computers. The next ten years will see

intensive mathematisation of fundamental scientific and engineering research, managerial functions, conduct of military operations, planning of economic affairs and even human thought. These years will also decide whether applied mathematics will remain an effective component in the great mathematical community, or will emerge as an independent scientific enterprise.

In U.S.A. there are at present seven mathematical institutes and two University departments specifically dedicated to the cultivation of applied mathematics. In India the Calcutta University has a full-fledged department of applied mathematics, but otherwise those taking interest in some branch of applied mathematics are not many. This is in striking contrast to what is happening in the United States of America, where mathematics is playing a very vital role in all spheres of human activity. The reasons for such a state of affairs are:

(i) The courses in mathematics are heavy and have not been integrated with other scientific subjects to make them attractive and beneficial to the students in the long run. (ii) The avenues open to mathematicians have not been fully explored and publicized. (iii) The curriculum in graduate education seldom leads students to take an interest in higher work. (iv) Industry and national research laboratories have not been made fully aware of the important role which mathematics is to play in their development. (v) No practical bias is given to graduate education to enable a number of students to find suitable employment in business and industry.

Thus there is lack of qualified students, qualified teachers and suitable publicity.

At present mathematics is taught indifferently in technical institutions. This has proved very harmful to the development of the subject, and it is to be feared that national plan-

ning for higher grade technical training may not be successful unless mathematics plays its fundamental role.

With this end in view a joint symposium of the Sections of Mathematics, Statistics and Engineering at the Forty-Second Meeting of the Indian Science Congress at Baroda set up a Committee under the Chairmanship of Prof. B. R. Seth, consisting of three engineers, two mathematicians and two statisticians to make recommendations on the teaching of mathematics in engineering institutions. Its report was discussed at the Forty-Third Meeting of the Indian Science Congress held at Agra and the final report is under preparation.

The following recommendations, if adopted, may help to improve the present state of affairs:

- (i) Establishment of a National Committee on Applied Mathematics. This will facilitate co-operation between Institutes and Universities, will call attention to new areas in which mathematics can be profitably used and will do a periodical survey of problems concerned with training and research in the subject.
- (ii) Establishment of graduate schools.
- (iii) Provision of an increasing number of optional papers in applied mathematics for the B.A. (Hons.) and M.A. Examinations in our Universities.
- (iv) Encouragement to students to take courses in other sciences with a significant mathematical content.
- (v) Invitations to mathematicians from industries and Government to teach at Universities and take part in their research activities on a temporary basis.
- (vi) Provision for employing mathematicians on the staff of industries and national laboratories to help them in their problems of production and research.

## ELECTRONIC COMPUTERS IN SCIENTIFIC RESEARCH

THE importance attached to the use of modern electronic computers in molecular quantum mechanics has been stressed in an International Conference held in Texas during December last. A resolution was passed unanimously, directing attention to the impressive results already obtained by high speed computers in the calculation of molecular and crystal properties, and claiming that these properties are of extreme importance in chemistry, physics

and biology. The resolution goes on to note that "progress of this work is greatly hampered by the fact that, due to their great cost, high speed computers are unavailable to most scientists in this field"; and therefore it "recommends that governments, industries, foundations and private philanthropists give special attention to the problem of providing more high speed computing facilities for use in molecular problems". Copies of the complete document

are being sent to government and other scientific agencies in Britain, the United States and elsewhere.

Regarding the provision of a limited number of these computers by the University Grants Committee during the next quinquennium in Great Britain, *Nature* observes that it would be a great pity if the number is unrealistically small. For, electronic computers have entirely changed the kind of problem (such as the structure of vitamin B<sub>12</sub> or a single protein molecule) which can be attacked successfully. As things are now, certain calculations have to

be sent from Britain to the United States, since they cannot be dealt with adequately in British Universities. One American firm alone expects to have nearly two thousand large computers in use at the end of another eighteen months or so. A similar situation is present in our country also, and some research workers, particularly in the field of crystallography, have to send their more extensive calculations to the United States for being worked out. It is imperative that a start should soon be made towards establishing a computational centre in India.

### TREATMENT OF INFECTIOUS HEPATITIS

IT is only fifteen years since the exact pathology of epidemic jaundice was determined and the idea of "catarrhal jaundice" gave way to that of "infectious hepatitis". In the absence of any specific remedy against the virus of infectious hepatitis, the application of recent knowledge of the liver's nutritional needs underlies the treatment of the disease. The earlier starvation diet is not altogether agreed upon. Whether protein should be given in excess or in only normal amount, whether fat should be restricted, whether exercise is bad for the liver—these are some of the questions which the physician may ask, and it is not possible to answer them at all dogmatically.

The value of a liberal diet, especially one containing much protein, is in keeping with observations made in Britain. But the benefit from a diet high in protein, when compared with that from a diet containing moderate or even small amounts of protein, is not remarkable, for it must be remembered that the experiments have always been carried out on adequately nourished patients, well able to stand up to what, in most instances, is a mild illness. Liberal feeding in hepatitis is not specific in the way that antibiotics are specific for many bacterial infections. It is known that protein, and in particular the amino acids, methionine and choline, are necessary for the health of the liver. The aim of liberal feeding is to ensure that the materials for repair are present in abundance.

There is no evidence that fat is harmful, and if the patient can manage it a balanced diet

containing a normal amount of fat is probably best.

The findings of Chalmers *et al.* that early activity had no harmful effect on the course of the disease is contrary to the usual teaching. But here, again, the patients studied were healthy and well fed before they fell ill. They were admitted to hospital, and, though they were not kept in bed, their activities were restricted. The problem is very different when the patient is a housewife with a house and young family to care for single-handed. The amount of work she must undertake is considerable, and it is in such circumstances that infectious hepatitis is likely to be prolonged and serious relapses may occur. Rest in bed should then be continued until the level of serum bilirubin has returned to normal.

In addition to a liberal diet many other substances, including amino acids, hormones and vitamins, have been tried in an endeavour to hasten recovery. Methionine and choline, amino acids containing sulphur, have no demonstrable effect. Insulin has been given in combination with a diet high in carbohydrate, but it is probably wiser to give carbohydrate alone.

On the whole it would appear that the average patient will do well on a commonsense regimen of rest with as liberal a diet as he can take. But when the illness is severe something more is needed; the most useful additions are large quantities of carbohydrate and vitamins of the B group—(*British Medical Journal*, Feb. 18, 1956, p. 389.)

## THE EMBRYOLOGY OF ANGIOSPERMS, A RETROSPECT AND PROSPECT

P. MAHESHWARI

Dept. of Botany, University of Delhi

THERE have been three periods in the history and progress of angiosperm embryology; the first in which several observers began to examine dissections, hand sections and later microtome sections of anthers and ovules under the microscope and gradually collected a mass of valuable information on the development and organization of the gametophytes, endosperm and embryo; the second in which such studies began to be undertaken on a comparative basis so that the data obtained could be used for taxonomic purposes; and the third and most recent in which embryology has become an experimental science having intimate contacts with physiology and genetics.

## DESCRIPTIVE EMBRYOLOGY

Among earlier workers the names of Amici, Schleiden, Hofmeister, and Hanstein are the most prominent. Amici (1824) discovered the pollen tube and later (1830) traced it to the mouth of the ovule. Schleiden (1837) followed its growth in many plants and established its occurrence as a general phenomenon in angiosperms. However, his enthusiasm for discovery and an innate keenness to be the first in everything led him to a grievous error, for he imagined having seen the tip of the pollen tube converting itself into the embryo. In the lively and sometimes rather heated controversy which followed, botanists divided themselves into two camps: some supporting Schleiden and others upholding the views of Amici who claimed that a "germinal vesicle" present inside the embryo sac gives rise to the embryo although the stimulation to its development was no doubt supplied by the pollen tube. To decide the question a prize was announced by the Imperial Institute of the Netherlands at Amsterdam. This was awarded to H. Schacht who wrote a large monograph with numerous figures all supporting the mistaken interpretations of Schleiden!

The issue was settled by the careful researches of W. Hofmeister (1849) who published a famous paper entitled "Die Entstehung des Embryo des Phanerogamen". Here he described his observations on 38 species belonging to 19 genera and showed that without exception the embryo originates from a pre-existing cell in the embryo sac and not from the pollen tube.

An exceptionally keen observer, Hofmeister also figured the reduction divisions in the pollen mother cells of *Tradescantia* although he could not correctly interpret the complicated series of changes undergone by the chromosomes. Elfving (1829) established the nature of the nuclei in the pollen grain and Strasburger (1884) demonstrated that the stimulation provided by the pollen tube is of a material and not merely a chemical nature. He succeeded in observing the fusion of the male and the female gametes in *Monotropa hypopitys* and since a similar demonstration had by now been made in many lower plants and animals, there remained no doubt that the essential feature of fertilization is the fusion of the two sexual nuclei.

Meanwhile, several investigators had joined the chase. To mention a few, Hanstein (1870) gave a very detailed account of the development of the embryo in *Capsella* and *Alisma*. Strasburger (1878, 1879) traced the origin of the adventive embryos of *Hosta* and the development of the female gametophyte of *Polypogonum*. Hegelmaier (1887) published a comparative account of the histology of the endosperm in many dicotyledons, and Treub (1891) announced his discovery of chalazogamy in *Casuarina*. With the rich collection of tropical plants in the botanical gardens and environs of Buitenzorg ready at hand, Treub also published several outstanding papers on the Lorantheae, Orchidaceae and Burmanniaceae.

In this gamut of new data, there was one vexing phenomenon. Since the pollen tube always brings two male gametes and only one fertilizes the egg, the problem remained as to what happens to the second male gamete. Also, what caused the renewed activity in the embryo sac leading to the formation of a large nutritive tissue, the endosperm? Nawaschin (1898) and Guignard (1899), working independently and using almost identical material, made the interesting discovery that in angiosperms we have a "double" fertilization, one male gamete fusing with the egg and the other with the two polar nuclei.\* This immediately provided the explanation for xenia and with the discoveries of Juel (1900) and Murbeck (1901) of the

\* For further details on the historical aspects of angiosperm embryology, see Baranov<sup>1</sup> and Souèges.<sup>2</sup>

parthenogenetic development in *Antennaria* and *Alchemilla*, the stage was now set for a generalized and connected account so ably written in 1903 by Coulter and Chamberlain. This was followed 26 years later by the publication of Schnarf's well known "Embryologie der Angiospermen" which remains a mine of information to this day.

Among the hundreds of papers published during the last 50 years mention must first be made of the very painstaking studies made by Souèges and Crété on the embryology of a very large number of genera and species belonging to various families. Wulff in Germany and Finn and his pupils in Ukraine have published a series of papers on the male gametophyte from which they conclude that the generative nucleus is always surrounded by its own sheath of cytoplasm, that normally the sperm nuclei also have their own sheaths, and that not only the male nucleus but the male cytoplasm also takes part in fertilization. There is no conclusive proof yet that the sperm cell enters the egg as such, but Wylie's (1941) studies on *Vallisneria* are quite suggestive of such an occurrence.

Concerning the development of the embryo sac we have a mass of literature at present, some of the principal contributors being Johnson, Geerts, Lagerberg, Dahlgren, Palm, Bambacioni, Håkansson, Cooper, Stenar, Johri, Fagerlind, Harling, Swamy and Subramanyam. Their studies have led to the correction of many old errors and emphasized the necessity of having a close series of stages before coming to any definite conclusions. To mention an example, the embryo sacs of species of *Lilium* and *Fritillaria* were studied many times by such masters as Guignard, Mottier, Sargent, Coulter and others and the material was repeatedly employed for class demonstration; yet, it was only in 1928, as the result of Bambacioni's brilliant work on *Fritillaria persica* and *Lilium candidum*, that the correct sequence of stages was understood. This led to the re-investigation of a number of plants which were previously supposed to fall under the *Lilium* or *Adoxa* type, resulting in much valuable information which has been reviewed elsewhere.<sup>3</sup>

The phenomena of apomixis and polyembryony have always attracted a good deal of attention. It was an apomictic *Hieracium* which baffled Mendel and many years passed before it became clear as to why the "pea laws" failed to apply in this case. Today several embryologists are engaged in studying the

methods of origin of non-haploid embryo sacs and of embryos from cells other than the egg.

Another recent and attractive line of research is the study of pollen tubes not only in the fixed but also in the living condition with the use of the phase microscope (see Steffen<sup>4</sup>). Of considerable interest to the cytologist are also the anther tapetum and the endosperm whose nuclei show many peculiarities in the behaviour of the chromosomes.

#### PHYLOGENETIC EMBRYOLOGY

It is a matter of common knowledge that external appearances of vegetative organs may sometimes lead to wholly incorrect ideas of relationships. Even experienced botanists have occasionally mistaken a leafless asclepiad for a species of *Ephedra*. The taxonomist, therefore, places greater reliance on the flower which is a more conservative organ than the root, stem or leaf. But if we assume phylogenetic trends in the external morphology of the flower, why not in the internal structures such as pollen, embryo sac, endosperm, and embryo, which are more protected from environmental influences and are therefore expected to be still more conservative. The appearance in 1931 of Schnarf's "Vergleichende Embryologie der Angiospermen" first brought to light the important role of embryology in taxonomical considerations.

The Cactaceæ, Callitrichaceæ and Empetraceæ are well known examples of families whose systematic position has often been disputed in the past. Embryology has given a clear lead in all the three cases and it is now generally agreed that the Cactaceæ belong to the Centrospermales, Empetraceæ to the Ericales, and Callitrichaceæ to the Tubifloræ.<sup>3</sup> On embryological as well as other grounds *Trapa* should be removed from the Onagraceæ and placed in a separate family, Trapaceæ. *Calochortus* with its monosporic 8-nucleate embryo sac is to be removed from the tribe Lilioideæ (Liliaceæ) and *Gagea* with the *Fritillaria* type to be transferred to the Lilioideæ.

While numerous examples can be cited of the value of embryology in helping us to decide between two alternative views of the relationships of a particular group of families, we shall confine ourselves here to a few on which work has been done in this country.

In many parts of India we have a marshy plant, *Sphenoclea zeylanica*, which is specially common in rice fields. This has usually been placed in the Campanulaceæ, but Airy Shaw<sup>5</sup> has recently suggested that the habit and anatomy show several significant features found



in the Phytolaccaceæ while other characters suggest the Primulaceæ. As a result of the work of Subramanyam<sup>6</sup> it has now been shown conclusively that *Sphenoclea* has no close connections with either the Phytolaccaceæ or the Primulaceæ.<sup>7,8</sup> On the other hand, the resemblances with the Campanulaceæ-Lobeliaceæ are so pronounced and unmistakable that Airy Shaw's view must be set aside.

Table I, which summarizes some of the anatomical and embryological characters of Phytolaccaceæ, Campanulaceæ and Sphenocleaceæ, clearly brings out the resemblances between the Campanulaceæ and Sphenocleaceæ.

TABLE I

Characters	Phytolaccaceæ	Sphenocleaceæ	Campanulaceæ
1 Anomalous secondary growth	Present	Absent	Absent
2 Ovule	Ana-campylotropous, bitegmic	Anatropous, unitegmic	Anatropous, unitegmic
3 Nucellus	Massive : persists as perisperm	Very thin and ephemeral	Very thin and ephemeral
4 Nucellar epidermis	Produces secondary parietal tissue	Destroyed by the developing embryo sac	Destroyed by the developing embryo sac
5 Endothelium	Absent	Present and conspicuous	Present and conspicuous
6 Endosperm	Free nuclear, haustoria absent	Cellular, with well-developed haustoria	Cellular with well-developed haustoria

The family Lemnaceæ consists of four genera in all, of which the flowers are so minute that they are easily overlooked. Recent work based on abundant flowering material of *Wolffia microscopica* and *Lemna paucicostata*<sup>9,10</sup> shows that the anther tapetum forms a periplasmodium, the pollen grains are 3-nucleate, the ovule is orthotropous, the embryo sac is of the Allium type, the endosperm is Cellular with a basal haustorial process, and the proembryo is without a large basal cell. One layer of endosperm cells persists in the seed and the micropyle is formed by the outer integument. In the Helobiales, with which Lawalrée<sup>11</sup> considers the Lemnaceæ to be closely allied, the micropyle is formed by the inner integument, the endosperm is free nuclear or Helobial, the proembryo has a large basal cell with dense cytoplasm and a hypertrophied nucleus, and the seed is exalbuminous. These differences are sufficiently marked to preclude any direct relationship between the two groups. On the other hand, there are significant similarities between the embryological characters of the Lemnaceæ and the Araceæ which support the usually accepted view that the Lemnaceæ have their closest allies in the Araceæ.

The genus *Exocarpus* comprises about 17 species, mostly Australian. Recently it has come

into some prominence owing to a suggestion of Gagnepain and Boureau<sup>12,13</sup> that it should be assigned to a separate family Exocarpaceæ to be transferred to the gymnosperms near the Taxaceæ. The case for this transfer rests on the "naked" ovule, articulated pedicel (re-calling *Podocarpus* and *Acmopyle*) and the presence of a pollen chamber. In his annual review of "Systematik der Spermatophyta" in *Fortschritte der Botanik* Suessenguth (1954) writes: "Da der Embryosack von *Exocarpus* bisher nicht bekannt ist, ist nach Ansicht des Ref. eine endgültige Beurteilung der Frage noch nicht möglich, wenn schon andere stärke

Übereinstimmungen von *Exocarpus* mit wirklichen Santalaceen sowie die eindeutige Angiospermie der Eu-Santalaceæ zunächst gegen die Annahme von Gagnepain und Boureau sprechen."

An embryological study carried out by Maheshwari and Ghosh<sup>14</sup> on *Exocarpus spartium* and *E. cupressiformis*, material of which was very kindly provided by Miss I. Cooke of Melbourne and Dr. H. S. McKee of Sydney, has shown that the plant is an undoubted angiosperm. No abnormalities were noticed in the development of the anther and the male gametophyte. There is a fibrous endothecium as in other angiosperms and the pollen grains are shed at the 2-celled stage. The ovule is orthotropous. The megaspore mother cell gives rise to a row of three cells of which the chalazal functions. The mature embryo sac is 8-nucleate with the usual angiospermic organization but differs from the other members of the Santalaceæ in not having the U or N form. The first division of the zygote is transverse. Subsequent divisions result in a long filament of cells which later produces the usual dicotyledonous embryo. There are indications of cleavage polyembryony resulting from a proliferation of the suspensor. In the development of the endosperm of *E. spartium* the primary

chalazal chamber becomes elongated and divides vertically into two cells each with a hypertrophied nucleus while the micropylar chamber shows repeated cell divisions and forms the main body of the endosperm.

The occurrence of 2-celled pollen grains, a normal 8-nucleate embryo sac, post-fertilization endosperm and division of the zygote by wall formation definitely prove that *Exocarpus* is an angiosperm although it may be regarded as an aberrant member of the Santalaceae.

#### APPLIED AND EXPERIMENTAL EMBRYOLOGY

Coming now to the comparatively new field of applied and experimental embryology, a fair amount of work has been done on the viability, storage and conditions of germination of pollen; the rate of pollen tube growth; and the inactivation of incompatibilities between the male and female gametes. Considerable success has also been achieved in the artificial stimulation of the ovary resulting in the development of seedless fruits and this has now become a standard practice in some countries in the cultivation of out-of-season tomatoes in glass-houses. Workers in California have also found it possible to eliminate the caprification (pollination) of calimyrna figs and ripen them by treatments with *para*-chlorophenoxyacetic acid or *para*-fluorophenoxyacetic acid.<sup>15</sup> Recently Nitsch<sup>16</sup> has successfully grown pollinated ovaries of tomato, tobacco, strawberry, bean and some cucurbits in artificial media, and those of tomato and gherkin ripened even to the extent of producing viable seeds. The growth of unpollinated ovaries was arrested but the addition of hormones to the culture medium enabled those of tomato to develop into parthenocarpic fruits.

An important aspect of experimental embryology is the artificial culture of excised embryos. This is of considerable interest to the plant breeder and the horticulturist: (1) it enables the rearing of hybrid embryos which may otherwise be doomed because of the "baneful" influence of the maternal tissues; (2) it affords a means of making quick tests of the viability of seeds; and (3) by this method it is possible to bypass the period of dormancy and reduce the time required for growing a plant to maturity. To the physiologist it is important as a tool for understanding the nutritional requirements of the growing embryo.

In general, the older the embryo the easier it is to excise it and culture it in an artificial medium. The chief difficulty lies in growing

young embryos not only because of possible injury to their tissues during dissection but also because their nutritive requirements are much more complex than those of larger embryos. About 15 years ago Van Overbeek and his co-workers introduced the use of coconut milk in the culture media but the results obtained were erratic and later it was found that Seitz-filtered malt extract is an effective substitute for coconut milk. However, no detailed analysis has yet been made of the particular component ("embryo factor") of coconut milk or malt extract which provides the stimulus for the growth of the embryos. Another point is that in culture young embryos do not always follow the normal course of development and differentiation. Not only is their growth slowed down, but there are often swellings, fasciations, formation of irregular bud-like growths and a premature differentiation of the radicle and plumule.

While some success has been achieved in the artificial culture of embryos and even anthers<sup>17,18</sup> there are a few other problems whose solution has so far defied all attempts. One is the induction of artificial parthenogenesis. This is of great interest to the breeder as a method of obtaining homozygous strains in two steps only instead of repeated selfing carried out for a number of generations. For, once we learn how to cause the haploid egg to form an embryo, it would be easy to double the number of chromosomes by treatment with colchicine. Several methods, both physical and chemical, have been tried to stimulate the egg. Among those most frequently quoted are exposure of the plants at critical periods to temperature extremes and other shocks; pollination with dead, X-rayed or foreign pollen; and chemical treatments; but the results obtained are inconclusive and the percentage of success is generally of little statistical significance. Further, even if the egg can be made to divide, it is much more difficult to initiate endosperm formation; and without the metabolites formed by the endosperm the embryo is unable to grow to maturity.

Of interest are also the adventive embryos found in *Citrus*, *Mangifera*, *Eugenia* and several other genera. They have the same genetical composition as the maternal parent, and are therefore of considerable value as a means of propagation of desirable varieties of fruit trees. Attempts to stimulate the production of adventive embryos in those plants, which do not normally have them, have however proved unsuccessful. Injections of hormones into the ovules cause the production of tumours from the

integumentary tapetum but no one has so far been able to grow them in artificial media and obtain seedlings from them.

The phenomenon of cleavage polyembryony is common in gymnosperms but not so in angiosperms where normally the egg gives rise to a single embryo. Since identical twins are useful in a study of the effects of heredity *vs.* environment, a method of inducing them is desirable. Recently Eunus<sup>19</sup> exposed developing seeds of *Hordeum vulgare* to X-rays. The embryos grew more slowly and often showed a number of proliferations but it remains to be seen whether they can be cultured to give rise to independent seedlings. In many members of the Ranunculaceae the seeds contain a rudimentary pear-shaped embryo in which the cotyledons are differentiated considerably after shedding. Haccius<sup>20</sup> treated fresh seeds of *Eranthis hiemalis* with undifferentiated embryos with a 0.1% aqueous solution of 2,4-dichlorophenoxyacetic acid. This caused the production of twin embryos in 3-8% of the seeds whereas the normal frequency of twinning is less than 0.3%. The twins are invariably fused at the radicular end but can be separated and grown to maturity in artificial media.

#### CONCLUSION

Considerable progress has been made in the descriptive and phylogenetic aspects of plant embryology, ever since Amici began his study of pollen tubes, but many families, particularly tropical, need further study. While no classification can be based on any one structure such as the embryo or endosperm, there is no doubt that a proper evaluation of all the data will prove useful in a better understanding of the interrelationships of many genera and families and in an improvement of the existing schemes of classification. Much less has, however, been done on experimental embryology as also pointed out by Wardlaw<sup>21</sup> in his excellent book on "Embryogenesis in Plants". This is no doubt due to the inaccessible position of the embryo in higher plants. Nature has put cunning safeguards upon the embryo in the form of multiple envelopes of several cell layers which must be crossed before it is possible to reach it. It is hoped that the technical difficulties involved in this process will be gradually conquered. While experimental studies cannot stand alone and a basic training in descriptive morphology is essential, it is desirable that the plant embryologist of the future, like his counterpart on the zoological side, should also have some fami-

liarity with physiological and biochemical methods. It is only sustained effort on these lines that will lead to a clear understanding of the complexity of the organismal phenomena involved in the origin, growth and differentiation of the embryo.

(In order to conserve space the older papers are not cited here. Reference to them will be found in Ref. 3.)

1. Baranov, P. A., *History of Plant Embryology in connection with the Development of Ideas on the Origin of Organisms.*, 1955, In Russian. Akad. Nauk USSR, Moskva.
2. Souèges, R., *L'embryologie végétale. Resume Historique*, 1934, Hermann & Co., Paris.
3. Maheshwari, P., *An Introduction to the Embryology of Angiosperms*, 1950, New York & London.
4. Steffen, K., "Zytologische Untersuchungen an Pollenkorn und-schlauch. I. Phasenkontrast-optische Lebenduntersuchungen am Pollenschlauch von *Galanthus nivalis*," *Flora*, 1953, **140**, 140.
5. Airy Shaw, H. K., "Sphenocleaceae," in *Flora Malesiana*, Ser. I., 1948, **41**, 27.
6. Subramanyam, K., "A contribution to our knowledge of the systematic position of the Sphenocleaceae," *Proc. Ind. Acad. Sci.*, 1950, **31B**, 60.
7. Rosén, W., "Endosperm development in Campanulaceae and closely related families," *Bot. Notiser.*, 1949, 137.
8. Crété, P., "Répartition et intérêt phylogénétique des albumens a formations haustoriales chez les angiosperms et plus particulièrement chez les gamopétales," *Ann. Sci. Nat., Bot.*, 1951, **12**, 131.
9. Maheshwari, S. C., "The embryology of *Wolffia*," *Phytomorphology*, 1954, **4**, 355.
10. —, "The endosperm and embryo of *Lemna* and systematic position of the Lemnaceae," *Ibid.*, 1956, **6**, 1.
11. Lawalrée, A., "L'embryologie des Lemnaceae. Observations sur *Lemna minor*," *Cellule*, 1952, **54**, 305.
12. Gagnepain, F. and Boureau, E., "Une nouvelle famille de Gymnospermes les Sarcopodacées," *Bull. Soc. Bot. Fr.*, 1946, **93**, 313.
13. —, "Nouvelles considérations systématiques à propos du *Sarcopus aberrans* Gagnepain," *Ibid.*, 1947, **94**, 182.
14. Maheshwari, P. and Ghosh, M., "Systematic position of *Exocarpos*," *Proc. 42nd Indian Sci. Congr.*, (Baroda), 1955, 234.
15. Crane, J. C. and Blondeau, R., "Hormone-induced parthenocarpy in *Calimyrna* fig and a comparison of parthenocarpic and caprifig syconia," *Plant Physiol.*, 1951, **26**, 136.
16. Nitsch, J. P., "Growth and development *in vitro* of excised ovaries," *Amer. J. Bot.*, 1951, **38**, 566.
17. Taylor, J. H., "The duration of differentiation in excised anthers," *Ibid.*, 1950, **37**, 137.
18. Sparrow, A. H., Pond, V. and Kojin, S., "Microsporangogenesis in excised anthers of *Trillium erectum* grown on sterile media," *Ibid.*, 1955, **42**, 384.
19. Eunus, A. M., "The effects of X-ray on the embryological growth of development of *Hordeum vulgare* L.," *J. Exptl. Bot.*, 1955, **6**, 409.
20. Haccius, B., "Experimental y in lucel, twinning in plants," *Nature*, 1955, **176**, 355.
21. Wardlaw, C. W., *Embryogenesis in Plants*, 1955, London & New York.

## LETTERS TO THE EDITOR

	PAGE		PAGE
Dielectric Behaviour of Mixture of Polar Gases at Microwave Frequencies—G. P. SRIVASTAVA .. .. .	111	A Preliminary Note on the Pharmacology of Evolvine—M. N. GURUSWAMI, T. R. KRISHNAMURTHY AND T. S. VAIDYANATHAN .. .. .	119
The Heat and Specific Heat of Mixing of He <sup>3</sup> and He <sup>4</sup> Solutions—BIPIN KUMAR AGARWAL .. .. .	112	Some Abnormalities in the Venous System of Rana tigrina Daud.—S. C. SHARMA .. .. .	120
The Elastic Scattering of 90 Mev Neutrons by Copper—G. Z. SHAH AND K. M. GATHA .. .. .	113	Occurrence of Johnius hololepidotus (Lacépède) in Indian Waters—G. SESHAPPA .. .. .	121
Kaemmererite from Sindhuvali Mines, Mysore District—M. N. VISWANATHIAH .. .. .	114	B-Chromosomes in Panicum coloratum—M. S. SWAMINATHAN AND JOGINDER NATH .. .. .	123
Unit Cell and Space Group of Cupric Ammonium and Potassium Oxalates—M. A. VISWAMITRA AND R. V. G. SUNDARA RAO .. .. .	115	Carotenoid in Pila virens (Lamarck)—(Miss) V. R. MEENAKSHI .. .. .	124
Correlation between Conductivity, Swelling and Shrinkage Properties of Ceramic Clays—AMAL K. BHATTACHARYA .. .. .	115	Polyploidy in Allamanda—NIRAD K. SEN AND N. N. ROY TAPADAR .. .. .	125
The Nature of Glycine soja Agglutinins—G. W. G. BIRD .. .. .	116	Mortality of Carp Fry due to Infection by a Parasitic Ciliate—S. J. KARAMCHANDANI .. .. .	126
Methyl Ethyl Ketone Peroxide as Initiator in Vinyl Polymerization—M. R. GOPALAN AND M. SANTHAPPA .. .. .	116	A New Stage in the Evolution of the Post-Notal Plates of Insects—A. C. MATHUR .. .. .	127
Chemistry and Antibacterial Activity of Nut Grass—SENICH RADOMIR, SUKH DEV AND M. SIRSI .. .. .	118	Life-History of Shorea robusta Gaertn.—A. NAGARAJA RAO .. .. .	128
		A New Genus of Indian Itonididae:—Kittada coimbatorensis, Gen. et Sp. Nov.—R. A. AGARWAL .. .. .	129

### DIELECTRIC BEHAVIOUR OF MIXTURE OF POLAR GASES AT MICROWAVE FREQUENCIES

PREVIOUS studies in the microwave region on gaseous mixtures have dealt with absorption<sup>1</sup> and line breadth constant.<sup>2</sup> The present note reports measurements of electric susceptibility of mixture of polar gases at moderate pressures in 3 cm. region. The technique employed is similar to that reported earlier from this laboratory.<sup>3-5</sup> Mixtures of ammonia with methyl bromide were used. All the chemicals were obtained in pure form and were passed through dehydrating towers before entering the flask where gases were mixed, and sufficient time was allowed before the mixture was introduced into the waveguide cell.

The experimental results for a typical mixture (1:3 of ammonia and methyl bromide) at a series of pressures are shown in Table I. In each row are given the partial pressures (columns 2 and 4) as also the contribution to ( $\epsilon - 1$ ) from the two components (columns 3 and 5), calculated from the data obtained earlier<sup>3,6</sup> for the pure compounds and the value of their partial pressures. The sum of these two is given in column 6 and may be compared with the observed value in column 7. Thus, it will be seen that the net susceptibility of the mixture does not show any appreciable deviation from the law of partial pressures. Measurements have also been made with other ratios for the mixture (1:1 and 3:1) and also for mixtures of ammonia and ethyl chloride in

various ratios, and in all cases, the law of partial pressures was observed to hold.

The author is thankful to Shri Krishnaji for guidance and to Shri Shanker Swarup for help in the work and to Dr. Prem Swarup and Shri Y. P. Varshni for taking interest in the work.

TABLE I

(Wavelength of radiation: 2.99 cm.;  $\text{NH}_3$  and  $\text{CH}_3\text{Br}$  mixture: 1:3)

Pressure Mixture	Partial Pressure $\text{NH}_3$	Value of $(\epsilon-1) \times 10^3$ for $\text{NH}_3$	Partial Pressure $\text{CH}_3\text{Br}$	Value of $(\epsilon-1) \times 10^3$ for $\text{CH}_3\text{Br}$	Sum of columns 3 & 5	Experimental $(\epsilon-1) \times 10^3$
1	2	3	4	5	6	7
cm.	cm.		cm.			
10	2.5	0.1	7.5	0.90	1.00	1.06
20	5	0.35	15	1.80	2.15	2.16
30	7.50	0.55	22.5	2.80	3.35	3.42
40	10	0.72	30	3.80	4.52	4.58
50	12.5	0.91	37.5	4.65	5.56	5.02
60	15	1.05	45	5.60	6.65	6.72
70	17.5	1.30	52.5	6.50	7.80	7.84
76	19	1.45	57	7.20	8.65	8.66

Dept. of Physics, G. P. SRIVASTAVA.  
University of Allahabad,  
Allahabad, December 22, 1955.

1. Hershberger, W. D., *J. Appl. Phys.*, 1946, **17**, 495.
2. Eleaney, B. and Penrose, R. P., *Proc. Phys. Soc.*, 1948, **60**, 540.
3. Krishnaji and Prem Swarup, *Zeits. f. Phys.*, 1953, **136**, 374.
4. —, *Ibid.*, 1954, **138**, 550.
5. Srivastava, G. P., *Curr. Sci.*, 1955, **24**, 409.
6. Krishnaji and Prem Swarup, *J. Chem. Phys.*, 1954, **22**, 568.

## THE HEAT AND SPECIFIC HEAT OF MIXING OF $\text{He}^3$ AND $\text{He}^4$ SOLUTIONS

THE heat and specific heat of mixing of  $\text{He}^3$ - $\text{He}^4$  mixtures have been calculated by Nanda<sup>1,2</sup> using the theories of (i) Heer and Daunt, (ii) van Laar (classical regular solution model, and (iii) de Boer and Gorter. In the present note these thermodynamic functions have been computed using the asymptotic theory of liquid  $\text{He}^3$ - $\text{He}^4$  mixtures, recently published by Goldstein.<sup>3</sup> The results are compared with those of other theories.

Using the value of  $\Delta\epsilon$  given by the asymptotic theory,<sup>3</sup> the heat of mixing ( $\Delta h$ ) of a mixture of  $\text{He}^3$  and  $\text{He}^4$  in cal. per mole of  $\text{He}^3$  is given by

$$(\Delta h)_{\text{molar}} = \frac{5}{2} \frac{1-X}{X} RT^{5/2} \frac{\zeta(5/2)}{\zeta(3/2)} \times \{ (T_\lambda)^{-3/2} - (T_\lambda^0)^{-3/2} \}, \quad (1)$$

where  $X$  is the mole fraction of  $\text{He}^3$  and  $\zeta$  the Riemann zeta function. The lambda temperature of the mixture  $T_\lambda$  and the lambda temperature of the symmetric component  $\text{He}^4$ ,  $T_\lambda^0$ , are related by

$$T_\lambda = T_\lambda^0 \left[ \frac{1-X}{1+X(V_3^0/V_4^0-1)} \right]^{2/3}, \quad (2)$$

$V_3^0$  and  $V_4^0$  being the atomic volumes per atom of  $\text{He}^3$  and  $\text{He}^4$ , respectively. On combining (1) and (2) it is easily seen that  $(\Delta h)_{\text{molar}}$  is independent of concentration. In Fig. 1 we have

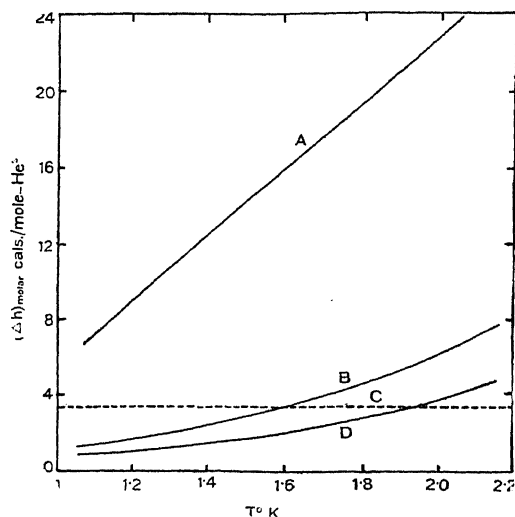


FIG. 1. The plot of calculated values of  $(\Delta h)_{\text{molar}}$ , the heat of mixing of liquid  $\text{He}^3$  in liquid  $\text{He}^4$ , for dilute solutions, against temperature.

A, de Boer and Gorter's theory (1% solution), B, Goldstein's theory, C, Van Laar's theory, D, Heer and Daunt's theory.

plotted values of  $(\Delta h)_{\text{molar}}$  for dilute solutions of  $\text{He}^3$  in  $\text{He}^4$  liquid against temperature. For comparison, values obtained from other theories<sup>1</sup> are also plotted. It will be noticed that the predicted variation of  $(\Delta h)_{\text{molar}}$  is markedly different for the different theories. Therefore, the need of experimental determination of the heat of mixing at different temperatures need hardly be emphasized to select a correct model for  $\text{He}^3$ - $\text{He}^4$  solutions. In Table I we have compared the value of  $(\Delta h)_{\text{molar}}$  according to different models with the single observation of Sommers, Keller and Dash<sup>4</sup> for a 8.6% solution at 1.02° K. The value according to the theory of Goldstein<sup>3</sup> lies closest to the observed value.

It has been pointed out by Nanda<sup>2</sup> that due to the non-availability of pure  $\text{He}^3$  in large quantities, it would be easier to collect experimental data on the specific heat of mixing. The

TABLE I

The heat of mixing for a mole of  $\text{He}^3$  for a 8.6% solution at  $1.02^\circ \text{K}$ .

Author	de Boer and Gorter	Heer and Daunt	van Laar	Goldstein	Sommers <i>et al.</i> Exp.
$(\Delta \bar{h})_{\text{molar}}$	3.35	0.68	3.02	1.123	1.98

expression for this thermodynamic function can be written as:

$$(\Delta C)_{\text{molar}} = \frac{25}{4} \frac{1-X}{X} RT^{3/2} \frac{\zeta(5/2)}{\zeta(3/2)} \{(T_\lambda)^{-3/2} - (T_\lambda^c)^{-3/2}\}. \quad (3)$$

Equation (3) gives only the temperature derivative of heat of mixing and not the observed specific heat of mixing. One always measures the total heat capacity of a mixture. Therefore, the definition of Nanda<sup>2</sup> is open to criticism. This point will be discussed in detail elsewhere.

In Fig. 2 we have plotted  $(\Delta C)_{\text{molar}}$  against temperature for dilute solutions. The figure

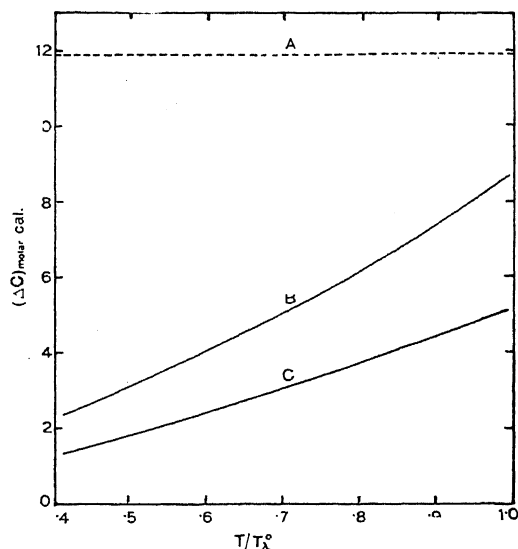


FIG. 2. The variation of  $(\Delta C)_{\text{molar}}$  with temperature for  $X \rightarrow 0$ .

A, de Boer and Gorter's theory; B, Goldstein's theory; C, Heer and Daunt's theory.

also shows the variation of  $(\Delta C)$  with temperature as predicted by the other theories.<sup>2</sup> It is found that the prediction of the theory of Goldstein is quite different from those of other theories. It is hoped that experimental determination of the specific heat of mixing will

point out the correct model for  $\text{He}^3\text{-He}^4$  mixtures.

Physics Dept., BIPIN KUMAR AGARWAL.  
Allahabad University,  
Allahabad, January 16, 1956.

1. Nanda, V. S., *Phys. Rev.*, 1954, **94**, 241.
2. —, *Ibid.*, 1955, **97**, 571.
3. Goldstein, L., *Ibid.*, 1954, **95**, 869.
4. Sommers, Keller and Dash, *Ibid.*, 1953, **92**, 1345.

## THE ELASTIC SCATTERING OF 90 Mev NEUTRONS BY COPPER

A CHARACTERISTIC nuclear density distribution for light elements has been obtained by Gatha, Shah and Patel<sup>1</sup> from an analysis of the experimental data on the nuclear scattering of 340 Mev protons on the basis of the first Born approximation. Subsequently, Gatha and Shah<sup>2</sup> have obtained a revised density distribution for such elements from the same experimental data by eliminating the contributions from the higher Born approximations. This revised characteristic nuclear density distribution, valid for light elements upto Al, is given by

$$\rho(\bar{r}) = a_1 \exp.(-b_1 \bar{r}^2) + a_2 \exp.(-b_2 \bar{r}^2) \times \{1 - b_3 \bar{r}^2 + b_4 \bar{r}^4\} \quad (1)$$

where

$$\begin{aligned} a_1 &= 0.12 \times 10^{39} \text{ cm.}^{-3}; \\ a_2 &= 0.25 \times 10^{39} \text{ cm.}^{-3}; \\ b_1 &= 8.62 \times 10^{26} \text{ cm.}^{-2}; \\ b_2 &= 1.09 \times 10^{26} \text{ cm.}^{-2}; \\ b_3 &= 0.44 \times 10^{26} \text{ cm.}^{-2}; \\ b_4 &= 0.13 \times 10^{52} \text{ cm.}^{-4}; \end{aligned}$$

while  $\bar{r} = r \times A^{-1/3}$  where A is the nuclear mass number. This distribution generates, in the nuclear optical model, the complex nuclear potential given by

$$V(\bar{r}) = -\hbar^2 v \bar{n}_\rho(\bar{r}) \quad (2)$$

where  $\bar{n} = \bar{n}_1 + i \bar{n}_2$  determines the nuclear complex refractive index, while  $v$  is the velocity of the incident nucleon. It has been found

that with  $\bar{n}_1 = 42 \text{ mb}$  and  $\bar{n}_2 = 14 \text{ mb}$ , the experimental data on the differential scattering cross-sections  $\sigma(\theta)$  as well as the absorption cross-sections  $\sigma_a$  and the total cross-sections  $\sigma_t$  for the nuclear scattering of 90 Mev neutrons by the light elements upto Al, can be reasonably correlated on the basis of the above complex nuclear potential.

It is, therefore, interesting to investigate whether the above complex nuclear potential can

similarly correlate the experimental data on the nuclear scattering of 90 Mev neutrons by a middle element such as Cu. It has been assumed, as before, that the Glauber approximation, discussed by Gatha and Mathur,<sup>3</sup> can be reasonably used for theoretical computations. It has been found that the theoretical values of  $\sigma_a$  and  $\sigma_t$  turn out to be slightly higher than the corresponding experimental values given by Bratenahl *et al.*<sup>4</sup> and Cook *et al.*<sup>5</sup> respectively. The theoretical curve for  $\sigma(\theta)$ , along with the experimental values of  $\sigma(\theta)$  given by Bratenahl *et al.*,<sup>4</sup> is shown in Fig. 1. It is clear

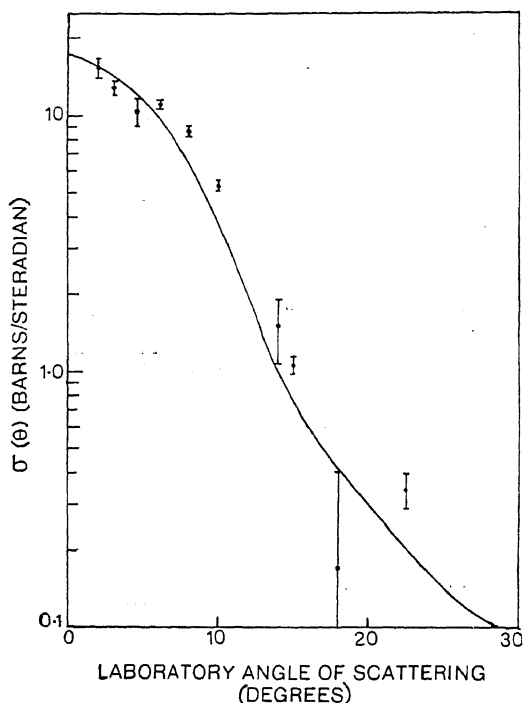


FIG. 1. Diffraction Pattern for the Nuclear Scattering of 90 Mev Neutrons by Copper.

that there is a reasonable agreement between the theoretical and the corresponding experimental values of  $\sigma(\theta)$ . Therefore, it can be concluded that the above complex nuclear potential, based upon the above characteristic nuclear density distribution, can approximately correlate the experimental data on the nuclear scattering of 90 Mev neutrons by a middle element such as Cu.

Physics Dept.,  
Institute of Science,  
Bombay-1, February 10, 1956.

G. Z. SHAH.  
K. M. GATHA.

1. Gatha, K. M., Shah, G. Z. and Patel, N. J., *Proc. Phys. Soc.*, 1954, **67 A**, 773.
2. —, (Unpublished).
3. —, and Mathur, A. L. *Curr. Sci.*, 1955, **24**, 43.
4. Bratenahl, A., Fernbach, S., Hildebrand, R. H., Leith, C. E. and Moyer, B. J., *Phys. Rev.*, 1950, **77**, 597.
5. Cook, L. J., McMillan, E. M., Peterson, J. M. and Sewell, D. C., *Ibid.*, 1949, **75**, 7.

### KÄMMERERITE FROM SINDHUVALLI MINES, MYSORE DISTRICT

IN India, the occurrence of kämmererite has been reported from three places—from the southern borders of Mysore by Jagapathi Naidu,<sup>1</sup> from Hulikere Mines, Hassan District, Mysore, by Viswanathiah,<sup>2</sup> and from Kondapalle range of hills, Kistna District, Andhra, by Srirama Rao.<sup>3</sup> No detailed optical and chemical work on kämmererites from India are however on record.

Chromite deposits occur near Sindhuvali, Mysore District, in association with ultrabasic rocks. During the course of a recent visit to the mines, a flaky violet coloured mineral was noticed in the form of veins traversing the chrome ore. An optical and chemical investigation of this mineral has shown that it is kämmererite, the chrome-bearing variety of chlorite. The occurrence of kämmererite in this area has not been reported so far.

The colour is a striking character in the case of kämmererite. The original name, kämmererite was given to the reddish violet micaceous mineral, reported from Lake Itkul, Biskersk, Perm, Russia, and was named after the mining director, A. Kaemmerer of St. Petersburg.<sup>4</sup> Winchell<sup>5</sup> has stated that chlorites containing chromium in any important amount replacing aluminium are easily recognised by their lavender or violet colour.

The association with chromite is another important factor in the identification of kämmererite. Phillips<sup>6</sup> has mentioned in describing the occurrence of the chromite that an almost constant associate is the purple-chrome-bearing chlorite, kämmererite and that this mineral is seen as a purple film filling the interstices between the chromite. The Sindhuvali mineral is characterised both by its violet colour and its association with chromite. Under the microscope it appears as thin flakes, showing deep colours, due to high dispersion and low birefringence, surrounding the opaque chromite ore. It shows faint pleochroism with

the following scheme: X = colourless, Y = Z = pale reddish yellow.

It is optically negative with very small optic axial angle. The refractive indices of the mineral determined by immersion method are:  $\alpha = 1.585$ ,  $\beta = \gamma = 1.590$ ,  $\gamma - \alpha = 0.005$ .

The material was separated using both bromoform and Clerici's solution. The pure crop has been analysed by Sri. V. M. Raghavan, and the chemical analysis of the mineral is as follows:

SiO<sub>2</sub>, 30.07; Al<sub>2</sub>O<sub>3</sub>, 19.84; Cr<sub>2</sub>O<sub>3</sub>, 2.80; Fe<sub>2</sub>O<sub>3</sub>, 1.82; FeO, 1.98; MgO, 30.60; CaO, nil; Na<sub>2</sub>O, nil; K<sub>2</sub>O, nil; H<sub>2</sub>O, 12.76 (Total = 99.87).

The structural formula of the mineral as calculated from the atomic proportions on the basis of (O, OH) = 18 atoms, is

(Mg, Fe)<sub>4.60</sub>(Al, Cr)<sub>2.41</sub>Si<sub>2.83</sub>O<sub>9.88</sub>(OH)<sub>8.12</sub>

The chromium oxide content of 2.80% substantiates that it is k  mmererite—a variety of penninite, as the percentage of Cr<sub>2</sub>O<sub>3</sub> is below 4.7

The occurrence of k  mmererite near Sindhuvali, in association with the chrome ore in the form of veins, suggests a hydrothermal origin. This mode of origin for the mineral has been proposed elsewhere by Diller,<sup>8</sup> Phillips<sup>6</sup> and Srima Rao.<sup>3</sup>

Dept. of Geology, M. N. VISWANATHIAH.  
Central College, Bangalore,  
March 16, 1956.

1. Jagapathi Naidu, P. R., *Proc. of the 30th Ind. Sci. Congress, Abstracts*, Part 3, 1943, 39.
2. Viswanathiah, M. N., *Curr. Sci.*, 1951, 20, 15.
3. Srima Rao, M., *Ibid.*, 1952, 21, 67.
4. Dana, E. S., *A System of Mineralogy*, 6th Ed., John Wiley & Sons, 1911, 652.
5. Winchell, A. N., *Amer. Min.*, 1936, 21, 651.
6. Phillips, F. C., *Quart. J. Geol. Soc. London*, 1927, 83, 639 and 647.
7. Hey, M. H., *Min. Mag.*, 1954, 30, 280.
8. Diller, *Bull. U.S. Geol. Surv.*, 1921, 725, A and B.

#### UNIT CELL AND SPACE GROUP OF CUPRIC AMMONIUM AND POTASSIUM OXALATES

CUPRIC ammonium oxalate-dihydrate Cu(NH<sub>4</sub>)<sub>2</sub>(C<sub>2</sub>O<sub>4</sub>)<sub>2</sub>·2H<sub>2</sub>O and cupric potassium oxalate-dihydrate CuK<sub>2</sub>(C<sub>2</sub>O<sub>4</sub>)<sub>2</sub>·2H<sub>2</sub>O are of interest because of their paramagnetic properties. They crystallise in the triclinic system and are isomorphous. Groth has given the following data for cupric ammonium oxalate:—

$$a : b : c = 0.6948 : 1 : 0.6061,$$

$$\alpha = 105^\circ 2', \beta = 104^\circ 57', \gamma = 90^\circ 18'.$$

However from its crystal habits, a different set of axes was found to be more convenient for reference.

Choosing this set of axes, regular oscillation, rotation and Weissenberg photographs were taken using CuK   radiation. High order reflections from the zero layer Weissenbergs taken about the three axes gave the following cell constants:—

$$a = 8.91 \text{ \AA}, \quad b = 10.65 \text{ \AA}, \quad c = 6.95 \text{ \AA}, \\ \alpha = 122^\circ 35', \quad \beta = 83^\circ 52', \quad \gamma = 109^\circ 7'.$$

These were found to be in very good agreement with the values obtained from the rotation photographs. Using the above values the volume of the unit cell was found to be 522.28 A.<sup>3</sup> The density as obtained by the flotation method was 1.94 gm./cm.<sup>3</sup> This gave two molecules per unit cell.

No systematic halvings were found. To determine, therefore, if the crystal belongs to P1 or P  , Wilson's statistical criterion for the existence or otherwise of a centre of symmetry was applied. Examination of the intensity distribution of the (001) projection was done in detail. The observed data were found to be very clearly consistent with the theoretical curve for the centro-symmetric case, as expected even from other grounds. The crystal thus belongs to the space group P  .

The cell dimensions of the isomorphous crystal cupric potassium oxalate were:

$$a = 8.66 \text{ \AA}, \quad b = 10.19 \text{ \AA}, \quad c = 6.86 \text{ \AA}, \\ \alpha = 120^\circ 41', \quad \beta = 83^\circ 52', \quad \gamma = 110^\circ 18'.$$

Complete structure analysis is under progress. Our thanks are due to Prof. R. S. Krishnan for his kind interest in the work and also Miss K. Sundaramma for loaning the crystals. Dept. of Physics, M. A. VISWAMITRA.  
Indian Inst. of Sci., R. V. G. SUNDARA RAO.  
Bangalore-3, February 14, 1956.

#### CORRELATION BETWEEN CONDUCTIVITY, SWELLING AND SHRINKAGE PROPERTIES OF CERAMIC CLAYS

ACCORDING to Katz<sup>1</sup> a solid swells when it takes up a liquid without losing its apparent homogeneity as its volume is enlarged and its cohesion is diminished. Katz has studied extensively the swelling of a large number of substances and he compares the behaviour of swelling substances to that of an ideal concentrated solution (Nernst.), the heat of dilution of which can be entirely changed into other forms of energy. Evidently the swelling of soils and clays is more complicated; but there is reason to believe that the orientation of molecules on the surface of clays as a result of the electrical properties of both the liquid



and the surface may follow the laws developed by Katz.<sup>1</sup> Terzaghi<sup>2</sup> has interpreted the swelling as due to the combined action of the surface tension of the water in the system and the elasticity of the solid components. Mattson<sup>3</sup> has explained the swelling of colloidal clays on the basis of the Donnan equilibrium. The investigations on the effects of the type of colloid and the nature of the exchangeable cations on swelling suggest that the concept of molecular orientation on surfaces and interfaces and around ions affords an interpretation of the process of swelling and shrinkage.

While studying the mineralogy of some Indian ceramic clays, viz., Rajmahal, Kasimbazar, Katni and Chitrakoot (obtained from the Government Pottery Works, Khurja), the conductivities of the suspensions of the above mentioned uniformly sieved clays were determined at constant temperature. Side by side the extent of the swelling and shrinkage properties of them were also carefully noted. It was interesting to observe that the swelling and shrinkage of these clays are in the same order as their conductivities.

The order of swelling and shrinkage was: Chitrakoot > Rajmahal > Kasimbazar > Katni. The corresponding specific conductances were: 2.19, 1.9, 1.66,  $0.73 \times 10^{-3}$  mho.

As the conductivity may be supposed to be due to the presence of the soluble salts, it may be argued that the swelling and shrinkage are intimately connected with the quantities of soluble salts present. This can be understood from the fact that a clay which is more chemically reactive is likely to be hydrated to a much greater degree with the result that swelling becomes more prominent. This is further supported by the fact that during the slow crystallisation of soluble salts, the clay structure is disrupted, creating what are known as 'salt boils',<sup>4</sup> which is responsible for the observed swelling. When the clay gets dried up, crystallisation of the soluble salts present in it takes place and the binding strength of the clay particles is lost and consequently shrinkage takes place. Hence the more soluble salts are present the more is the shrinkage or swelling. It is interesting to mention that observations have already been made<sup>4</sup> where the presence of soluble salts in soils imparts a damaging effect to it due to the gradual crystallisation of salts resulting into 'salt boils' and shrinkage. Therefore it may be said that the crystallisation of soluble salts is also definitely responsible for the swelling and shrinkage properties of ceramic clays.

Thanks are due to Professor A. K. Bhattacharya for his helpful suggestions and constructive criticism.

Dept. of Chemistry, AMAL K. BHATTACHARYA.  
Agra College, Agra, January 4, 1956.

1. Katz, J. R., *Trans. Faraday Soc.*, 1933, **29**, 279.
2. Terzaghi, K. V., *Colloid Chemistry*, 1931, **3**, 65.
3. Sante Mattson, *Soil. Sci.*, 1932, **33**, 301.
4. *Soil Mechanics for Road Engineers*, Her Majesty's Stationery Office, London, 1952.

### THE NATURE OF GLYCINE SOJA AGGLUTININS

FOLLOWING the demonstration<sup>1</sup> of complete non-specific cold agglutinins in *Glycine soja*, Bird<sup>2</sup> has demonstrated that it is possible to make extracts of these seeds specific for human red cells of group B by absorbing them first with O and then A<sub>1</sub> cells. He also reported<sup>3</sup> that the cold agglutinins of *Glycine soja* were identical with the agglutinins in these seeds which reacted strongly on rabbit's cells and upon albumin suspensions of human blood cells at 37° C.<sup>3</sup> Further experiments have indicated that the B-specificity shown by these extracts after absorption with O and A<sub>1</sub> cells is exhibited only when cells suspended in saline are tested. With cells suspended in albumin the absorbed extracts are quite non-specific. The eluates obtained from various absorbing cells were also found to be non-specific when tested, even at 37° C., with both saline and albumin suspensions of human blood cells. These experiments will be completely described elsewhere along with a theory which may serve to explain the structure both of *Glycine soja* agglutinins and the similarly reacting complete non-specific cold agglutinins (auto-agglutinins) which are often present in human sera. Blood Transfusion Dept., G. W. G. BIRD.  
Armed Forces Medical College,  
Poona, March 3, 1956.

1. Bird, G. W. G., *Curr. Sci.*, 1953, **22**, 273.
2. —, *Ibid.*, 1954, **23**, 13.
3. —, *Nature*, London, 1955, **176**, 1127.

### METHYL ETHYL KETONE PEROXIDE AS INITIATOR IN VINYL POLY- MERIZATION

METHYL ETHYL KETONE PEROXIDE (MEKP) has not been so far employed as a catalyst in vinyl polymerizations. Studies of variations of per cent. monomer conversions against time (Fig. 1 a) with MEKP at 70° C. in the case of styrene, methyl methacrylate and methyl acrylate have

indicated the nature of first order reaction, the absence of period of induction and suitability of the catalyst for further studies in the polymerization of monomers in bulk as well as in solution.

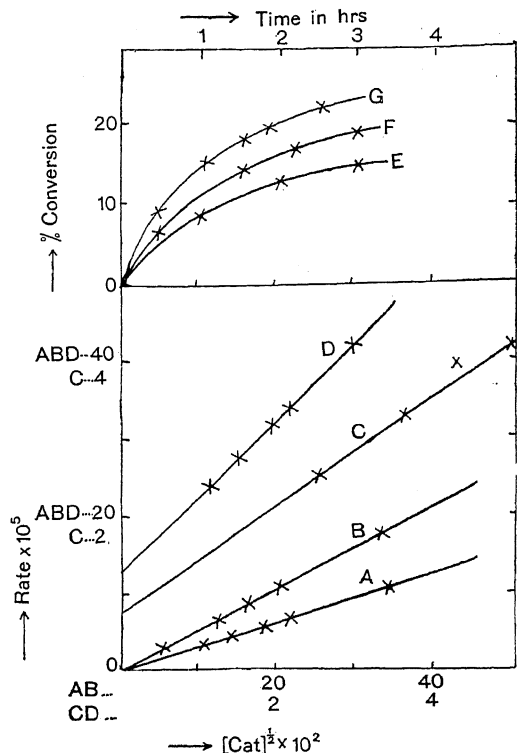


FIG. 1. (a) % Conversion vs. Time (hours) at 70° C.  
E, Methyl methacrylate ( $M = 4.6$ ) in benzene solution  
F, Styrene (bulk)  
G, Methyl methacrylate (bulk)  
(b) Rate vs.  $[\text{Cat}]^{1/2}$  at 70° C.  
A, Methyl methacrylate ( $M = 4.6$ ) in benzene  
B, Methyl methacrylate (bulk)  
C, Styrene (bulk)  
D, Methyl acrylate ( $M = 5.5$ ) in ethyl-acetate

In conformity with the behaviour of vinyl monomers polymerising under the influence of free radicals, a regular variation of overall rate ( $R$ ) with  $[\text{Cat}]^{1/2}$  (Cat—catalyst MEKP; Fig. 1 b) with various monomers ( $M$ ) in bulk and solution was observed. A linear relationship was also obtained between reciprocal degrees of polymerization ( $1/p_n$ ) and overall rates ( $R$ ) (Fig. 2 a) in bulk and at low  $[\text{cat}]$  according to the equation

$1/P_n = (k_t R / k_p^2 [\text{M}]^2) + C_M + (C^{\text{cat}} R^2 / K^2 [\text{M}^3]) + C_S [\text{S}/\text{M}]$  in which the third and fourth terms of right-hand side are negligible and absent respec-

tively. The constants in the above equation can be easily evaluated graphically. Utilizing the value of transfer constants for the monomers ( $C_M$ ) given by intercepts in Fig. 2 a, it was possible to plot  $(1/P_n - C_M)/R$  against  $R$  and obtain transfer constant for the catalyst  $[C^{\text{cat}}]$  and the ratio of specific rate constants for termination and propagation,  $k_t/k_p^2$ , from the slope and intercepts of the plots in Fig. 2 b. Utilizing the slopes of Fig. 1 b and intercepts of Fig. 2 b it was possible to evaluate rates of initiation ( $R_i'$ ). The results are given in Table I.

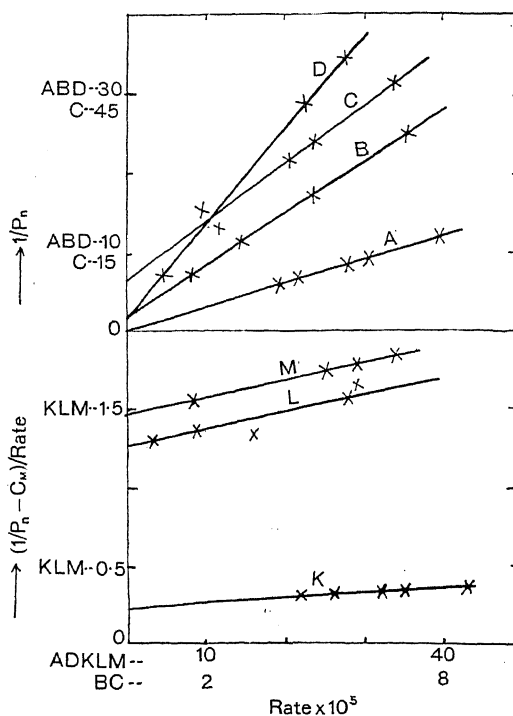


FIG. 2. (a) Rate vs. Reciprocal Degree of Polymerization at 70° C.  
A, Methyl acrylate ( $M = 5.5$ )  
B, Methyl methacrylate ( $M = 4.6$ )  
C, Styrene (bulk)  
D, Methyl methacrylate (bulk)  
(b)  $(1/P_n - C_M)/R$  vs.  $R$   
K, Methyl acrylate ( $M = 5.5$ ) at 70° C.  
L and M, Methyl methacrylate (bulk) at 65° and 70° C.

A fuller paper containing the complete results, the significance of the values of the various constants with their activation energies and the nature of decomposition of MEKP will be published elsewhere.

We thank Messrs. V. S. Vaidyanathan and V. Mahadevan of our laboratory for supplying

TABLE I

Temp. °C.	Monomer	$k_t/k_p^2$	$C_M$	$C_{cat}$	$R_f/[Cat]$
65	Methylmethacrylate	122.7	$2.0 \times 10^{-5}$	$7.46 \times 10^{-3}$	$2.083 \times 10^{-6}$
70	do	103.3	$3.0 \times 10^{-5}$	$9.2 \times 10^{-3}$	$2.440 \times 10^{-6}$
70	do. in benzene soln. (M=4.6)	84.67	$2.0 \times 10^{-5}$	$2 \times 10^{-3}$	$5.31 \times 10^{-7}$
70	Styrene	1085	$1.2 \times 10^{-4}$	0.2174	$10.68 \times 10^{-6}$
70	Methyl acrylate	7.563	$1.8 \times 10^{-5}$	$7.69 \times 10^{-2}$	$5.733 \times 10^{-5}$

us a few results in the case of styrene and methyl acrylate.

University Physical                      M. R. GOPALAN.  
Chem. Lab.,                                M. SANTHAPPA.  
Madras-25, March 2, 1956.

### CHEMISTRY AND ANTIBACTERIAL ACTIVITY OF NUT GRASS

NUT GRASS [*Cyperus rotundus* (Linn.)] is a common weed plant belonging to the family Cyperaceæ represented by more than 60 species in India.<sup>1</sup> Dry tubers are commercial articles. The main use of the essential oil of *C. rotundus* is in medicine and perfumery. The tubers are useful in infusion or as soup in fever, diarrhoea,

dysentery and other disorders of the bowel.<sup>2</sup> Romans used it as an emmanagogue in uterine complaints.<sup>3</sup> It is not known whether these properties are due to the oil or the non-volatile constituents.<sup>4</sup>

The medicinal properties of the essential oil obtained from the tubers of *C. rotundus* have been subjected to a pharmacological study. A short note on the chemistry and antibacterial activity of the essential oil and its fractions is presented below.

The tubers of different origin were steam-distilled or extracted with alcohol. The physical properties of the different types of oils obtained are given in Table I. Yield of oil varied from 0.3-0.5%.

TABLE I

Physical properties of the oils obtained from *C. rotundus*

Type of oil	Colour	Distillation range (10 mm.)	$n_D^{21^\circ}$	$[\alpha]_D^{21^\circ}$	$d_{23}^{23}$
Madras variety steam distilled	.. Yellow green	112°-164°	1.5104	±0.00	1.0101
Madras variety alcohol extraction	.. Green	110°-135°	1.5098	+1.40	0.9990
Madras variety steam distilled residue of alcoholic extraction	Brown green	110°-164°	1.5180	..	1.0207
Bangalore variety	.. Dark brown	..	1.4934	..	0.9533

*C. rotundus* oil (Madras) was fractionally distilled, when components with the following properties were obtained (Table II).

TABLE II

Physical properties of the fractional distillates of *C. rotundus* oil (Madras variety)

Fraction No.	Nature of the compound	B.P.	$n_D$	$[\alpha]_D^{30}$	$d_4^{30}$	% Yield
1	Hydrocarbon I (Cyperene I)	113°/10 mm.	1.500 at 30°	-16	0.9303	6 of the oil
2 A.	do. II (Cyperene II)	129°/10 mm.	1.5072 at 30°	+13.8	0.9289	14
2 B.	Hydrocarbon II was hydrogenated for one double bond and a substitution compound obtained	95°/3 mm.	1.4520 at 25°	+12	..	..
3	Alcoholic fraction (Cyperol)	148°/10 mm.	1.5105 at 26°	-16.2	..	..
4	Ketonic fraction (Cyperon)	168°/10 mm.	1.5242 at 30°	+66.4	..	..

The antibacterial activity was evaluated by the filter-paper disc method in which 8 mm. filter-paper discs are placed in an agar plate previously seeded with the test organism, 0.1 ml. of the oil put on the discs and the zone of inhibition measured after 24 and 48 hours incubation. A significant zone of inhibition maintained over a period of 72 hours was the criterion used in assessing bacteriostasis.

The essential oil of *C. rotundus* (Madras variety) and its various components obtained after fractional distillation were tested against *Staphylococcus aureus*, *E. coli*, *E. typhosum*, *Vibrio cholerae*, and *Shiga*, Schmitz and Sonne strains of *Shigella*. The oil inhibited the growth of only *Staphylo aureus* and was ineffective against the other organisms. Amongst the fractions, cyperone was completely inert, while the hydrocarbon fractions, cyperene I and II were more potent than the oil and cyperol. Qualitatively, they differ in that the cyperenes also inhibit the growth of *Shigella sonne*. Hydrogenation of cyperene II did not adversely affect the antibacterial activity.

Detailed pharmacological investigations will be reported elsewhere.

Our thanks are due to Prof. D. K. Banerjee for making available the compounds for pharmacological investigations.

Dept. of Organic Chem., SENICH RADOMIR.\*  
and Pharmacology Lab., SUKH DEV.  
Indian Inst. of Science, M. SIRSI.  
Bangalore-3, March 8, 1956.

\* Present address: Belgrade Faculty of Forestry, Department of Chemistry, Belgrade (Yugoslavia).

1. Watt, G. *Commercial Products of India*, John Murray, London, 1908, p. 464.
2. Kirtikar, K. and Basu, B., *Indian Medicinal Plants*, 1918, p. 1356.
3. Nadakarni, A. K., *Indian Materia Medica*, 1954, 1, 428, Popular Book Depot, Bombay.
4. Sanjiva Rao, B., Poniker, P. B. and Sudburrough, J. J., *J. Indian Inst. Sci.*, 1925, 8, 35.

## A PRELIMINARY NOTE ON THE PHARMACOLOGY OF EVOLVINE

EVOLVINE is a liquid alkaloid from *Evolvulus alsinoides*, an indigenous plant of India (vernacular name—*Vishnugrandhi*) (B.P. 160° C. at 0.05 mm. Hg). It was prepared by one of us (T. S. V.) and made available for pharmacological tests. With the amount available, a few preliminary pharmacological tests were carried out on dogs.

Six dogs, of varying weights (5 to 10 kilos), were used. Chloralose (100 mg./kg.) was

used as anaesthetic, a 1% solution being given intravenously. Trachea was cannulated and respiration recorded by a Marey's tambour. Blood pressure was recorded from a femoral artery. A femoral vein was cannulated for injection of drugs. The drug was administered as a 1% aqueous solution. Varying doses were tried, 0.5 mg./kg.; 1.5 mg./kg.; 2.0 mg./kg. (Fig. 1, 4) and 4.0 mg./kg. The last two doses

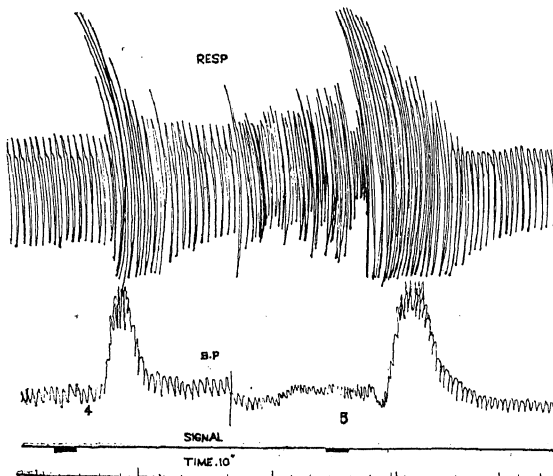


FIG. 1.

Dog. 9 Kilos, chloralose anaesthesia.  
Blood Pressure and Respiration recorded.  
Time signal and Time marking (10'') recorded.

\* At 4, 2.0 mg./kg. of evolvine was injected into the femoral vein.

At 5, 0.1 c.c. of lobeline solution (0.3 mg.) was injected into the femoral vein.

Note the similarity of time of onset and type of blood pressure and respiratory responses.

produced marked effects on the blood pressure and respiration. There was a marked rise of blood pressure while respiration was accelerated with an increase in amplitude. There was a time-lag between the intravenous administration of the drug and the onset of the effects. The interval was much shortened when the drug was given directly into one of the carotid arteries (Fig. 2, 6). With proportionate increase in dosage there was graded response. The response was not abolished by atropine (2 mg./kg.). Tetraethylammonium (T.E.A.), a potent ganglionic blocking agent, blocks the effect of the compound (Fig. 3, 8). The aqueous solution is fairly alkaline with a pH of about 9.0. Administration of solutions of sodium bicarbonate or potassium hydroxide, with the same pH, i.e., 9.0, did not produce similar effects (Fig. 3, 7). Lobeline administered similar to drug produced identical results (Fig. 1, 5).

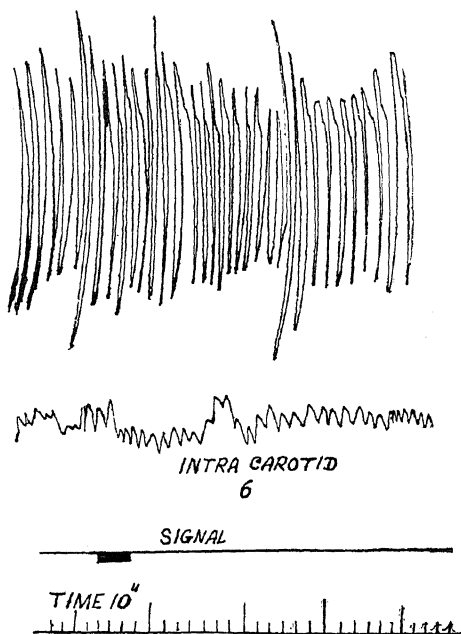


FIG. 2. At 6, 0.5 mg. of evolvine was injected into the carotid artery.

Note the quicker onset.

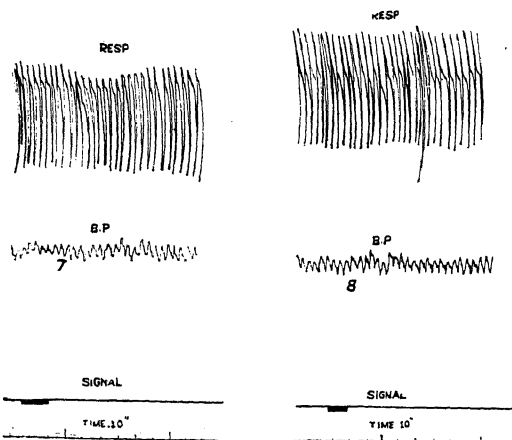


FIG. 3. At 7, 0.2 c.c. of potassium hydroxide (pH 9.0) was injected into the carotid artery.

Between 7 and 8 the animal was given T.E.A. 5 mg./kg. and an interval of 10 minutes was allowed.

At 8, 2.0 mg./kg. of evolvine, injected into the femoral vein, is seen to produce practically no effect.

The above findings show that we have a drug that probably acts on the carotid chemoreceptors similar to lobeline. The time-lag with intravenous administration and the quicker response on intracarotid administration point out the carotid chemoreceptors and/or higher

cranial centres as the probable sites of action. Stimulation of the carotid chemoreceptors by drugs like nicotine, acetylcholine or lobeline results in a rise of blood pressure and an increase in the depth and rate of respiration due to reflex stimulation of the vasomotor and respiratory centres. The fact that T.E.A. is able to block the action of the drug narrows down the site to the synaptic junction in the carotid chemoreceptors. Alkalinity of the solution is not responsible for the action, as is evidenced by the lack of response after equi-alkaline solutions of sodium bicarbonate and potassium hydroxide. Also, it has been shown that increasing the acidity of the coursing blood stimulates the carotid chemoreceptors while depression is obtained after increased alkalinity. Due to shortage of material, further experiments (such as denervation of carotid sinus nerve, etc.) to confirm the above findings, could not be performed.

Thus the drug is shown to have powerful stimulatory action on the respiration and blood pressure similar to lobeline, probably acting mainly on the carotid chemoreceptors. It will be an addition to the range of analeptics available now-a-days. The effect on other synaptic situations will be investigated when more of the drug is available.

Dept. of Pharmacology, M. N. GURUSWAMI,  
Madurai Medical College,  
Madurai

Dept. of Pharmacology, T. R. KRISHNAMURTHY,  
Govt. College of  
Indigenous Medicine,  
Madras

Pharmaceutics Dept., T. S. VAIDYANATHAN,  
Madras Medical College,  
Madras, March 1956.

#### SOME ABNORMALITIES IN THE VENOUS SYSTEM OF *RANA TIGRINA* DAUD.

SEVERAL abnormalities in the venous system of frogs have been recorded.<sup>1-6</sup> I came across the following abnormalities in the venous system of a fully grown male Indian Bull frog (Figs. 1, 2).

(i) The right renal portal, instead of terminating in the respective kidney, continues, into persistent posterior cardinal vein upto innominate into which it opens. (ii) Posterior vena cava is absent in the region of kidneys although its remnant is present in the region of liver. (iii) There are no renal veins, but two inter-renals, from the left kidney join to form a

single vessel, the 'united inter-renal', which connects the left kidney with the persistent posterior cardinal vein. It also receives venules from the right kidney as well as the spermatic vein from the right testis.

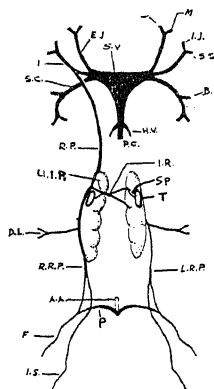


FIG. 1. A.A., Anterior abdominal vein. D.L., Dorso-lumbar vein. E.J., External jugular vein. F., Femoral vein. H.V., Hepatic vein. I., Innominate vein. I.J., Internal jugular vein. I.R., Inter-renal vein. L.P.R., Left renal portal vein. M., Mandibular vein. M.C., Musculo-cutaneous vein. P., Pelvic vein. P.C., Posterior caval vein. R.P., Right posterior cardinal vein. R.P.P., Right renal portal vein. S.C., Subclavian vein. S.S., Subscapular vein. S.V., Sinus venosus. I., Ischiadic vein. U.I.R., United inter-renal vein. Sp., Spermatic vein. T., Testis.

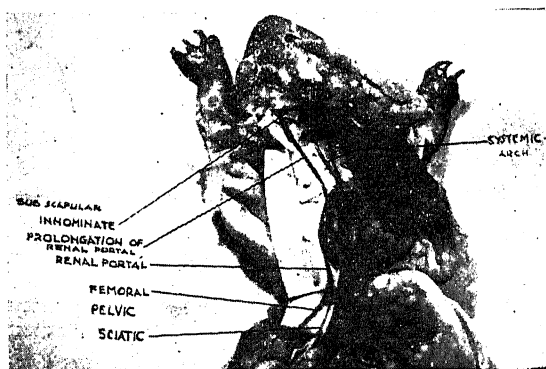


FIG. 2

From the above, it appears that during metamorphosis, the posterior portions of the right and left posterior cardinal veins, which serve as principal collecting vessels from the hinder region of the body of tadpole, failed to fuse in a single median vena cava. Further, the left posterior cardinal vein disappeared while right one has persisted. Probably this accounts for the absence of posterior vena cava in the region of kidneys.

Due to the normal arrangement of the veins on the left side, the blood from the left hind

limb is brought to the left kidney; from there it reaches to the persistent cardinal vein through united inter-renal and finally into innominate. The venous blood from the right side goes to the right kidney through the right renal portal and a part of which capillarises in it; the blood is then collected by another set of capillaries into the united inter-renal. It is, therefore, quite likely that a part of blood from the right hind limb is directly taken to sinus venosus without undergoing any renal portal circulation through the persistent posterior cardinal vein. Some blood from the hind limbs goes to liver through the anterior abdominal vein, which is present in this frog as in normal condition. The blood from the liver goes to sinus venosus through the anterior portion of the posterior vena cava.

In order to trace the veins, they were injected with Ranvier's Purssian Blue gelatine solution.<sup>7</sup>

Grateful thanks are due to Dr. Daya Krishna and to Prof. B. C. Mahendra for suggestions.

Dept. of Zoology,  
Jaswant College, Jodhpur,  
December 7, 1955.

S. C. SHARMA.

1. Parker, W. N., *Proc. Zool. Soc.*, 1889, 145.
2. Shore, T. W., *J. Anat. Physiol.*, 1899, 34, 398.
3. O'Donoghue, C. H., *Anat. Anz.*, 1910, 36, 355.
4. —, *Ibid.*, 1913, 43, 135.
5. —, *Trans. Roy. Soc. Edin.*, 1931, 57, Part I, 179.
6. Bhaduri, J. L., *Proc. Zool. Soc.*, 1929, 177.
7. Lee, Bolles, *The Microtome's Vade Mecum*, 1946, p 236.

## OCCURRENCE OF *JOHNIUS HOLOLEPIDOTUS* (LACÉPÈDE) IN INDIAN WATERS\*

WHILE slight changes have been introduced in the nomenclature of Indian Sciænids by Fowler<sup>1,2</sup> and Weber and Beaufort,<sup>3</sup> no species essentially different or additional to those described by Day<sup>4,5</sup> have so far been recorded from Indian waters. It was interesting to find therefore some specimens of *Ghols* among the catches of the Government of India trawlers in February 1955, which were distinct from all the species described by Day<sup>4,5</sup> for Indian waters as well as by Weber and Beaufort<sup>3</sup> for the Indo-Australian archipelago. They were also different from other *Ghols* usually occurring in Bombay markets and in the trawler

\* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam.

catches by their more elongate form, smaller eyes, truncate to double-emarginate caudal fin, a dark axillary blotch and, in fresh specimens, a row of shining spots along the lateral line on either side of the body. Detailed examination has brought the above *Ghols* into the species described as *Johnius hololepidotus* (Lacépède) by Fowler<sup>2</sup> and Smith.<sup>6</sup> The following are the diagnostic characters of the Indian examples based mainly on a single specimen which is at the Central Marine Fisheries Research Station. A photograph of the specimen is given in Fig. 1.

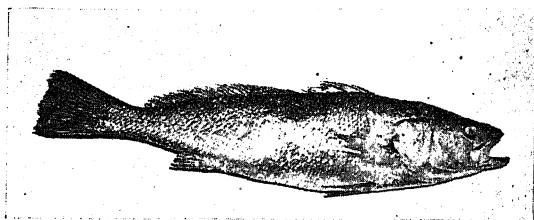


FIG. 1. Photograph of Indian specimen of *Johnius hololepidotus* Lacépède—right view.

**Description.**—B. VII; D.X., I, 27; A.II, 7; P.18; V.I, 5; C.18. Head about 4 in standard length; depth  $4\frac{1}{4}$ ; snout a little over 3 in head; eye 7 or even a little more in head; 2 in snout and a little over 2 in interorbital distance; interorbital convex. Lower jaw slightly longer than upper; six pores below mandibular symphysis. No mandibular barbel. Posterior end of maxilla reaches to below hind edge of eye. Snout has no lateral lobes. No palatine teeth. In lower jaw, teeth in two series, outer villiform and inner enlarged and conical. In upper jaw three front teeth on each side large and widely separated. Operculum with two blunt, spine-like processes; pre-opercle entire.

**Fins.**—5th dorsal spine the longest, about 3 in head, 4th and 3rd next in order; 2nd anal spine 5 in head and about  $\frac{1}{3}$  shorter than the 1st ray. Anal commences opposite about 12th dorsal ray; base 5 in soft dorsal.

**Scales.**—On body feebly ctenoid, continued on the caudal fin but not on the soft dorsal and ventral. Tubular scales 56 upto base of caudal fin and some more (not easily countable) on caudal fin. Immediately above lateral line there are about 25 special scales interspersed with others and appear in fresh specimens as a row of silvery spots along the sides of the body. These scales are slightly larger than the others and stand out prominently in the wet specimens on account of their silvery sheen. Nine scales between lateral line and

spinous dorsal; 17 between lateral line and base of ventral; 21 between lateral line and ventral middle line.

**Caudal** may be described as truncate to double-emarginate, the truncate nature being interrupted by a slight projection of the middle portion of the fin. Least depth of caudal peduncle about  $3\frac{1}{2}$  in head.

**Colour.**—Grey superiorly; whitish grey below. A large dark axillary blotch, i.e., the fleshy process at the base of pectoral fin large and dark.

The total length of the preserved specimen is 104 cm., the caudal being 10.5 cm. Ten individuals were dissected and examined for gonad condition and it was found that some of the females were in stage IV of maturity.

Fowler<sup>2</sup> gives the geographical distribution of *Johnius hololepidotus* (Lacépède) as follows: Eastern Tropical Atlantic, Mediterranean, Red Sea, Madagascar, Natal, South Africa, Western Australia, South Australia, Victoria, Tasmania, New South Wales and Queensland.

In the above instance of the occurrence of the species in the Saurashtra waters of India as many as 57 specimens (all full grown adults) were reported to have been caught in a single haul during bull-trawling near Porbunder, at a depth of 22-26 fathoms. The specimens were considered as 'unusual' and 'new' by some of the fishermen and fish merchants in Bombay. The author did not notice the species in the earlier and subsequent catches of the trawlers (during the years 1953, 1954 and 1955) but Shri K. H. Mohamed (personal communication) has noticed specimens somewhat similar on some previous occasions. It is clear, however, that the species must be rather rare in Indian waters, if it is not a migrant from the Red Sea or the African Coast where it is said to form a good fishery.

My thanks are due to Shri K. H. Mohamed for help in taking the detailed measurements.

Offshore Fisheries

G. SESHAPPA.

Res. Unit of C.M.F.R.S.,  
Sassoon Dock, Bombay-5,  
January 14, 1956.

1. Fowler, H. W., *J. Bombay Nat. Hist. Soc.*, 1926-1929, 31, 32 and 33.
2. —, *Bull. U.S. Nat. Mus.*, 1933, 12.
3. Weber, M. and De Beaufort, L. F., *The Fishes of the Indo-Australian Archipelago*, 1936, 7.
4. Day, F., *Fishes of India*, 1877-88.
5. —, *Fishes of British India*, 1889, 2.
6. Smith, J. L. B., *The Sea Fishes of Southern Africa*, 1949.

# **B-CHROMOSOMES IN *PANICUM* *COLORATUM***

THE presence in germ cells of certain chromosomes in excess of the normal complement found in root tips has been recorded in several plants like maize, rye, *Sorghum*, *Poa*, etc. These chromosomes are in many cases smaller than the regular chromosomes, may be heterochromatic and may pair among themselves when two or more of them are present. They seldom pair with the regular chromosomes and usually have no discernible effects on plant characters except that an accumulation of them leads to a reduction in pollen- and seed-fer-

red to as 'B' or accessory or supernumerary chromosomes to distinguish them from the 'A' or primary chromosomes (see review by Müntzing<sup>1</sup>). In the present report, the behaviour of B-chromosomes in plants of *Panicum coloratum* L., identified during the course of our cytological studies in the tribe *Panicaceae* of *Gramineae*, is described.

*Panicum coloratum* is a native of Africa and is a good fodder grass. Meiosis was studied in five plants during microsporogenesis in preparations made by the propino-carmin technique (Swaminathan *et al.*<sup>2</sup>) and in Feulgen squashes. At diakinesis and metaphase I, 18

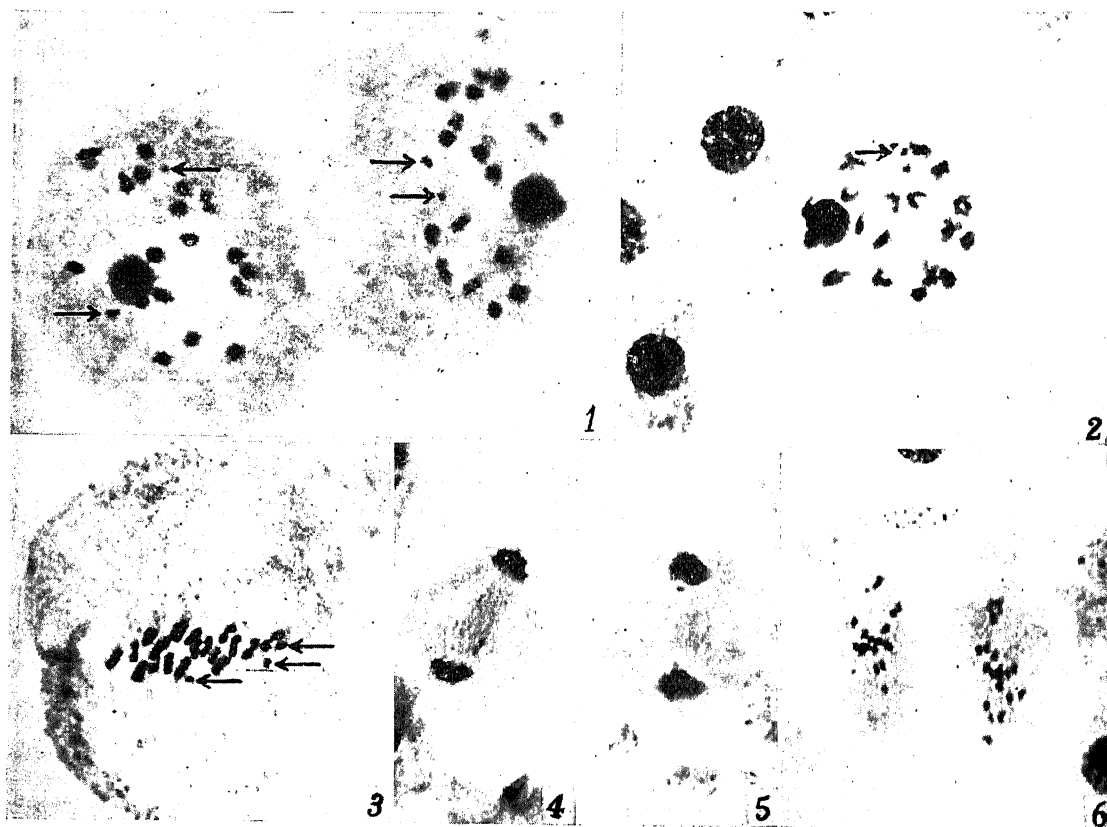


FIG. 1. Diakinesis, 18 bivalents and 2 B-chromosomes.  
FIGS. 2 and 3. Diakinesis and Metaphase I respectively in a plant with 3 B-chromosomes.  
FIG. 4. Late Anaphase. I. An undivided B-chromosome is going to one pole.  
FIG. 5. Regular separation of a B-chromosome which has divided during the first division.  
FIG. 6. Irregular separation of chromosomes at Anaphase II resulting from the presence of several B's.  
Arrows indicate B-chromosomes (Magnification of Microphotographs,  $\times 750$ ).

tility and plant vigour. The most striking feature of such chromosomes is their persistence in germ cells and absence in root tips. In view of these distinct characteristics and their uncertain genetic role, they are commonly refer-

bivalents were observed. Besides these, there was one accessory chromosome in three plants; there were two in one plant and there were three in another (Figs. 1-3). All the pollen mother cells examined contained these



chromosomes which were stained in the same way as the normal chromosomes. They were Feulgen-positive. The number of B-chromosomes was usually constant in the different pollen mother cells of a plant; in the plant with two B-chromosomes, however, only one could be identified in some cells. The pairing of the regular complement was in no way affected by the presence of the B-chromosomes. The B's themselves did not show pairing both at diakinesis and metaphase I in any of the 100 cells examined in each plant. They were also never found to be attached to the normal chromosomes. The mean chiasma frequency per bivalent of the regular complement at diakinesis and metaphase I in a plant with one B was 1.874 and 1.855 respectively. The values were nearly the same in the plants with two and three B's.

The B-chromosomes divided at metaphase of either the first or second division. When the division took place at MI, they separated to the poles and got included in two of the spores of the tetrad at the end of the second division. When there was no division during MI, the B's went to either pole and divided during MII (Figs. 4 & 5). In the plants with two and three B-chromosomes, each of them showed an independent behaviour, i.e., one may divide during the first division and the others during the second division. Occasionally, a B-chromosome undergoing division lagged in the equatorial plate while the regular chromosomes had completed division and reached the poles. Division of the B-chromosomes during the second division followed by their irregular separation resulted in the accumulation of five and six B's in spores of the plant with three B-chromosomes. The presence of several divided B-chromosomes at metaphase II seemed to disturb the anaphase movement of normal chromosomes (Fig. 6). Probably as a result of this, there was 20% pollen sterility in the plant with three B-chromosomes in contrast to the 5 to 10% sterility shown by the other plants. Due to extensive seed-shedding in these plants, critical data on seed fertility could not be gathered.

The B-chromosomes could also be seen in the pollen. In most cells, they divided and went to the opposite poles during the first pollen mitosis; in a few cases the divided B's were found to proceed to the same pole. Pollen transmission of the B-chromosomes is thus possible.

Seeds from the *P. coloratum* plants were germinated and the somatic chromosomes were studied in orcein and feulgen squashes made from the tips of primary roots. No B-chromosomes have so far been observed in the root tip cells. Attempts are being made to find out whether these chromosomes are present in shoots and young leaves.

To summarise, the B-chromosomes in *P. coloratum* are absent in root tips, do not pair but undergo a mitotic division during meiosis, divide during pollen mitosis and are not heterochromatic. Their presence causes no visible changes either in the morphological characters or vigour of plants but accumulation of five or more of them during the second division of meiosis results in irregularities in the separation of the normal chromosomes and consequently in some degree of pollen abortion. Detailed studies on large populations of *Panicum coloratum* are now in progress to gather information on the adaptive and genetic significance of the B-chromosomes and the causes for their elimination in roots. Colchicine treatment of seeds has been done to ascertain how chromosome doubling affects the number and pairing behaviour of the B-chromosomes.

We are very grateful to Dr. S. M. Sikka and Dr. P. N. Bhaduri, for advice and to Dr. B. P. Pal, for his interest in the study.

Indian Agric. Res. Inst., M. S. SWAMINATHAN.  
New Delhi-12, JOGINDER NATH.  
February 21, 1956.

1. Müntzing, A, *Caryologia, Suppl.*, 1954, **6**, 282.
2. Swaminathan, M. S., Magoon, M. L., and Mehra, K. L., *Ind. J. Genet. and Plant Breeding*, 1954, **14**, 87.

#### CAROTENOID IN *PILA VIRENS* (LAMARCK)

GOODWIN<sup>1</sup> has remarked that information on the carotenoid distribution of the lower forms of fresh-water animal life is meagre. This is particularly the case with the molluscs. While the carotenoid distribution of a fairly good number of marine molluscs has been studied, our knowledge of the fresh-water molluscs is limited only to a few forms like *Planorbis corneus*, *Limnæa stagnalis* and the New World species of the apple snail, *Pila canaliculata*. Comfort<sup>2</sup> investigated the last of these species and reported the occurrence of carotenoids in the eggs and the liver of the new-born larvæ

and adults. The eggs of this species are pigmented and laid out of water. Species of *Pila* whose eggs are laid in burrows and are unpigmented are found in India, and Goodwin<sup>2</sup> has pointed out that it would be interesting to know whether these forms are completely devoid of carotenoids. The present note deals with the carotenoids of the South Indian species of the apple snail, *Pila virens* (Lamarck).

The digestive gland (liver), uterus and testis were studied for the presence of carotenoids. For the extraction of the pigment the method given by Nicola and Goodwin<sup>5</sup> and for saponification the method given by Goodwin and Srisukh<sup>6</sup> were followed. The pigments were separated by the chromatographic method using alumina as adsorbent and light petroleum with varying amount of ether as developer. The identification of pigments was done by the study of their absorption spectrum and the quantitative estimation by the colorimetric method using a photo-electric colorimeter.  $\beta$ -Carotene is practically the only carotenoid present in *Pila virens*, only a trace of  $\alpha$ -carotene being present. There is no trace of xanthophylls.

The quantitative distribution of carotene in the digestive gland, testis and uterus was studied in the normally active animal and also during the breeding season and hibernation. Table I summarises the result.

TABLE I

Organ	Amount in $\mu\text{g./g. wt.}^*$		
	Normal	Breeding season	Hibernating (6 months)
Digestive gland	734	590	615
Testis	65	250	65
Uterus	50	175	44

\* Mean value for five experiments.

It is seen from the table that normally there is a good amount of carotene in the digestive gland of the animal which, however, decreases during the breeding season. The testis and uterus, on the other hand, normally contain only a negligible amount of carotene, but which shows considerable increase during the breeding season. This suggests a mobilisation of the pigment.

From controlled feeding experiments carried out, the source of carotene could be traced to the food of the animal, consisting of aquatic plants like *Vallisneria* with large amount of

chlorophyll, xanthophyll and carotenes. As shown in a previous investigation,<sup>7</sup> the digestive gland is the sole site of absorption of digested food in the animal, and as carotene is the only carotenoid pigment present in this organ, it is evident that carotene is selectively absorbed from the food. This is confirmed by the fact that the extract of the digestive gland has a certain amount of destructive effect on xanthophylls and not on carotenes. Generally in the molluscs, as Goodwin<sup>3</sup> has pointed out, xanthophylls predominate and in *Mytilus xanthophylls* are selectively absorbed as shown by Scheer.<sup>8</sup>

My thanks are due to Prof. R. V. Seshaiya for guidance, to Dr. Venkateswarlu for help in taking the absorption spectrum, and to the Government of India for the award of a research scholarship.

Dept. of Zoology, (Miss) V. R. MEENAKSHI.  
Annamalai University,  
Annamalainagar,  
January 23, 1956.

1. Goodwin, T. W., *The Comparative Biochemistry of Carotenoids* (Chapman and Hall), 1952, 201.
2. —, *Ibid.*, 1952, 212.
3. —, *Ibid.*, 1952, 178.
4. Comfort, A., *Nature*, 1947, **160**, 333.
5. De Nicola, M. and Goodwin, T. W., *Exp. Cell. Res.*, 1954, **7**, 23.
6. Goodwin, T. W. and Srisukh, S., *Biochem. J.*, 1949, **45**, 268.
7. Meenakshi, V. R., *J. Animal Morph. Physiol.*, 1954, **1**, 35.
8. Scheer, B. T., *J. Biol. Chem.*, 1940, **136**, 275.

### POLYPLOIDY IN ALLAMANDA

SEVERAL species of the genus *Allamanda* have been introduced into the gardens for their extreme beauty. Their shining green foliage, large golden yellow or purple flowers and the ease with which these climbing shrubs can be trained on trellis or trimmed to desired size are their special attractions. The plants do not set seed, though occasionally spiny globular fruits are seen in some plants, but it is reported that some species were introduced through seeds. They can, however, be easily propagated by cuttings or grafted.

The commonly grown species are *A. violacea*, *A. neriifolia*, *A. cathartica*, *A. grandiflora*, *A. nobilis*, *A. schottii*, *A. magnifica* and *A. williamsii*. According to Bailey,<sup>1</sup> with the exception of *A. violacea* and *A. neriifolia*, all the other species found in the gardens are probably varieties of *A. cathartica* Linn.

Chromosome numbers have been reported for two species of *Allamanda* which according to

Bailey<sup>1</sup> are varieties of *A. cathartica*. Darlington and Ammal<sup>2</sup> have quoted  $2n=18$  chromosomes for *A. willamsii* observed by Sugiura,<sup>3</sup> while Pathak *et al.*<sup>3</sup> observed the same number of chromosomes  $n=9$  in *A. grandiflora* Hook.

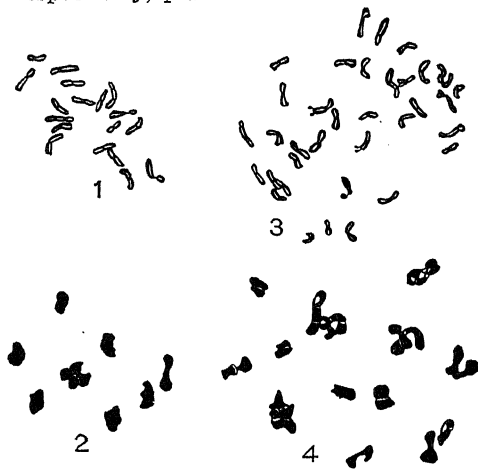
Among the two horticultural types in our nursery, *A. violacea* is so conspicuously different from the other type, *A. cathartica* var. *nobilis* syn. *A. nobilis* T. Moore, that it was thought desirable to study whether there is any cytological basis for their differences. *A. violacea* is readily distinguished from the *A. cathartica* varieties for their thicker leaves and wine purple-coloured flowers, the *A. cathartica* flowers being golden yellow. Among the other differences rough surface of stem and leaves due to the presence of hairs, subpetiolate and elliptical fleshy leaves and slightly larger pollen may be mentioned.

Cytological studies of the two types of *Allamanda* have revealed that the conspicuous difference of *A. violacea* from the other type is associated with doubled chromosome number in its complement. In *A. cathartica* var. *nobilis* studied, the chromosome number is  $n=9$  and  $2n=18$ , similar to the number reported by Sugiura<sup>4</sup> and Pathak *et al.*,<sup>3</sup> for the two horticultural species of *Allamanda*, while in *A. violacea* the chromosome number is  $2n=36$ .

Mitotic chromosomes were studied in well spread metaphase plates from aceto-orcein squash of root tips. Root tips of stem cuttings were treated in 0.2% coumarin solution for 2½ hr., heated in 9 parts of 2% aceto-orcein and 1 part of NHCl and finally squashed in 1% aceto-orcein. Eighteen chromosomes in *A. cathartica* (Fig. 1) ranged from 1.8-3.6  $\mu$  in length and had median or sub-median constriction. A pair of satellited chromosomes could easily be distinguished. In *A. violacea* (Fig. 3) 36 chromosomes are seen with two pairs of satellited chromosomes. The size of chromosomes ranged from 1.8-3.8  $\mu$  in length.

Meiotic chromosomes were studied in pollen mother cells fixing the flower-buds in acetic alcohol (1:3), mordanting in 4% iron alum for 10 min., smearing in aceto-carmin, and finally removing the cytoplasmic stain by running 45% acetic acid inside the coverslip, warming and pressing both at the time of staining and destaining. Nine well spread bivalents are seen at the meiotic metaphase of *A. cathartica* (Fig. 2). In *A. violacea* though bivalents and quadrivalents are most common, all types of configurations from univalents to hexavalents are seen (Fig. 4). In the 10 metaphase plates examined the mean frequency of I-VI

configurations were 1.0, 6.6, 0.6, 4.0, 0.2 and 0.5 respectively, per cell.



FIGS. 1-4.

Mitotic and Meiotic Metaphase Plates of *Allamanda cathartica* var. *nobilis* (Figs. 1 and 2) and *A. violacea* (Figs. 3 and 4),  $\times 1,090$ .

From the number of chromosomes and meiotic configurations, it may be concluded that *A. violacea* is a polyploid type in *Allamanda*. It should be considered as a distinct species from the races of *A. cathartica* like var. *grandiflora*, var. *willamsii* and var. *nobilis*, the common horticultural species of *Allamanda*, for its conspicuous morphological differences in vegetative and reproductive parts and having double the number of chromosomes.

Applied Botany Section, NIRAD K. SEN.  
Indian Inst. of Tech., N. N. ROY TAPADAR.  
Kharagpur, India, January 16, 1956.

1. Bailey, L. H., *The Standard Cyclopaedia of Horticulture*, 1953, 1.
2. Darlington, C. D. and Ammal, E. K. J., *Chromosome Atlas of Cultivated Plants*, 1945, George Allen & Unwin Ltd.
3. Pathak, G. N., Singh, B., Tiwari, K. M., Srivastava, A. N. and Pande, K. K., *Curr. Sci.*, 1949, 18, 347.
4. Sugiura, T., 1936, quoted from Darlington and Ammal, 1945.

#### MORTALITY OF CARP FRY DUE TO INFECTION BY A PARASITIC CILIATE\*

DURING the course of certain riverine investigations on the availability of fish seed of major carps in the river Ganga at Dighwara (Bihar) in the period June-July 1952, a case of mortality of carp fry, was observed in appreciable

\* Published with the permission of the Chief Research Officer, Central Inland Fisheries Research Station, Calcutta.

numbers, while rearing carp fry in glass jars in the field laboratory, due to the infection by a parasitic ciliate, *Trichodina* sp.

On 24-6-1952, a sample of one hundred carp fry from the collections, obtained from the river Ganga, was kept in a clean glass jar ( $4\frac{1}{2}'' \times 4'' \times 8''$ ) containing 1.25 litres of river-water and were fed on plankton, collected from a nearby nursery tank. On the following day, six carp fry were found dead which was attributed to the injury and shock, incident to collection and segregation. On 26-6-1952, however, there was heavy mortality of carp fry (55.3%) in the same jar which was considered unusual, since the carp fry normally recover from the shock of collection, etc., within 24 hours. Microscopic examination of living and dead carp fry revealed that they were heavily infected with *Trichodina* sp. The entire sample was then examined and the number of ciliate parasites, harbouring in the various parts of each living individual, was counted. Out of 42 living carp fry 33 were found infected. The infected fry were preserved in 2% formalin for further study.

Fry measuring 6-7 mm. were infected 100% and harboured 30-50 parasites each on the body, specially on and near the fins. The infection in fry measuring 8-9 mm. was 65% and 77.8% respectively and they harboured 25-40 parasites. Microscopic examination of the dying (14 specimens) and dead fry (18 specimens) showed that the number of ciliates was far more (average number of parasites, 44) on the former than on the latter (average number of parasites, 21) suggesting that in all probability the ciliates abandon the host soon after death. The fry reared in the jar were emaciated and sluggish in their movement, in spite of the fact that they were regularly fed on live zoo-plankton.

A similar case of mortality of carp fry due to the infection of *Trichodina* sp. was also observed by the author at Nimtita (W. Bengal) on 4-8-1949, when carp fry were kept in an enamel tray for 2-3 days. The percentage of mortality in this case could not be determined as there was no record of initial number of carp fry in the tray.

This protozoan is capable of free living in the plankton also and the infection might have taken place either from the river-water or from the pond-water from where the plankton was collected. The parasites increased in large numbers in the jar and thus were responsible for the mortality. It is also seen that the rate of binary fission of *Trichodina* sp. is more

during the monsoon period than in other seasons of the year.

Tripathi<sup>4,5</sup> and Lagler<sup>2</sup> state that some species of *Trichodina* may cause epidemic mortality in fresh-water fish hatcheries and nursery ponds. The mortality of fresh-water fry due to other parasitic infection is also not uncommon in the hatcheries (Flakes,<sup>1</sup> Seaman,<sup>3</sup> Wagner and Perkins<sup>6</sup>). The poor yield of carp fry from nurseries, very often reported in India, could be partly due to mortality caused by parasitic infection.

Central Inland S. J. KARAMCHANDANI.  
Fisheries Res. Sub-Station,  
Allahabad, February 22, 1956.

1. Flakes, K. G., *Progressive Fish-Culturist*, 1950, 12, No. 2, 63.
2. Lagler, K. R., *Studies in Fresh-Water Fishery Biology*, 1950, p. 91.
3. Seaman, W. R., *Progressive Fish-Culturist*, 1951, 13, No. 3, 139.
4. Tripathi, Y. R., *J. Marine Biol. Assoc. U.K.*, 1948, 27, 440.
5. —, *Rec. Ind. Mus.*, 1956 (in press).
6. Wagner, E. D. and Perkins, C. L., *Progressive Fish-Culturist*, 1952, 14, No. 3, 127.

#### A NEW STAGE IN THE EVOLUTION OF THE POST-NOTAL PLATES OF INSECTS

SNODGRASS<sup>1</sup> has explained the possible evolution of the post-notal plates from the intersegmental membranes. The intersegmental membrane, in most of the arthropods has become chitinized secondarily, as a result of which the primitive intersegmental fold becomes the sub-marginal ridge, the *antecosta*, while its corresponding external groove becomes the *antecostal suture*. From the anterior wall of the *antecosta* has developed a narrow flange, the *acrotergite*. In the case of the tergum, the *acrotergite* together with the *antecosta* and the *antecostal suture* has fused secondarily with the tergum of the following segment. The *acrotergite* in the mesotergum has remained a narrow flange, but the *acrotergite* in the metatergum and the *acrotergite* in the first abdominal tergum have enlarged and extended forward up to the posterior margin of the preceding tergum, thus reducing the intersegmental membranes. As these *acrotergites* have reduced the intersegmental membranes between the mesonotum and the metanotum, and between the latter and the first abdominal tergum, these *acrotergites* form the post-notal plates. Though these post-notal plates have fused secondarily with the terga of the following segments, they belong morphologically to the tergal plates of the preceding segments.

While examining the thorax of *Brachythemis contaminata* Fabr. (Libellulidae, Odonata) the author came across a new stage in the evolution of the post-notal plates. In this insect also, the intersegmental membrane has been chitinized, thereby forming the mesoacrotergite and well-developed mesontecosta between the meso- and meta-thorax. The important feature is that the mesoantecosta has remained fused with the metanotum, while a membrane has developed between the base of the mesoantecosta and the mesoacrotergite (Fig. 1). This membrane remains much folded and is visible only when the mesoacrotergite is pulled from

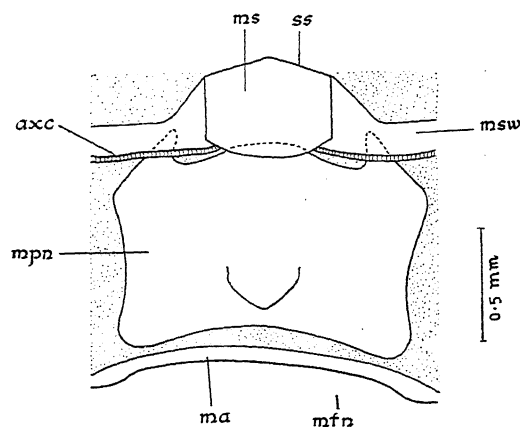


FIG. 1. Dorsal view of the intersegmental region between the meso- and meta-thorax. *acc*, axillary cord; *ma*, mesoantecosta; *mpn*, mesopost-notum; *ms*, meso-scutellum; *msw*, mesoscutellar wing; *mfn*, metanotum; *ss*, scuto-scutellar suture.

the compound metanotum. The presence of a membrane between the acrotergite and the base of the antecosta has not been noticed so far. Snodgrass has described the evolution of the post-notal plates in three stages; the stage described here fits in between the last two stages described by him. Therefore, it may be regarded as a stage in the evolution of the mesopost-notal plates. This shows that the evolution of the post-notal plates takes place in four stages and not three as described by Snodgrass. The new stage can be represented diagrammatically as shown in Fig. 2.

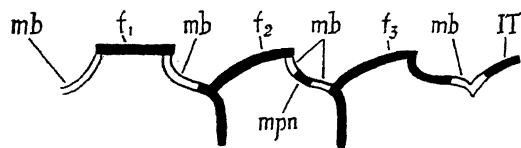


FIG. 2. Diagrammatic representation of the new stage. *mb*, membrane; *mpn*, mesopost-notum; *f1*, prothoracic tergum; *f2*, mesothoracic tergum; *f3*, metathoracic tergum; *IT*, first abdominal tergum.

The author's thanks are due to Dr. R. Rakshpal, for guidance and to the University of Lucknow, for financing the studies.

Dept. of Zoology,  
The University, Lucknow,  
February 18, 1956.

A. C. MATHUR.

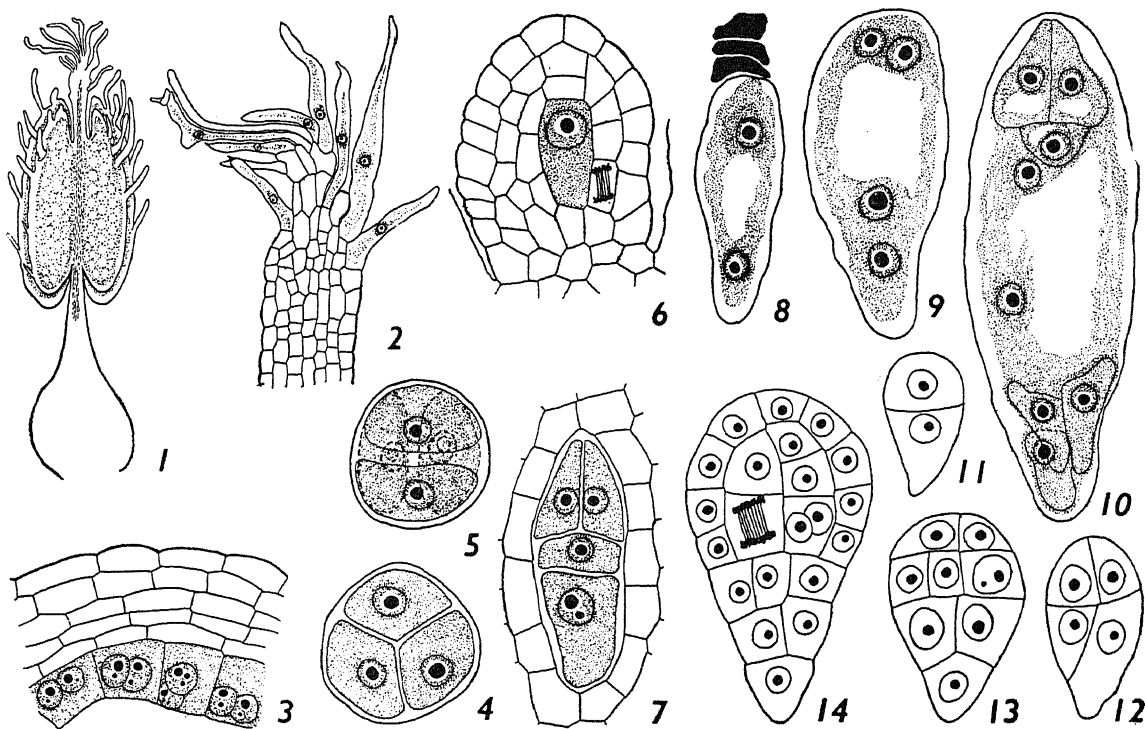
1. Snodgrass, R. E., *Principles of Insect Morphology*, McGraw-Hill, New York, 1935, 176.

## LIFE-HISTORY OF *SHOREA ROBUSTA* GAERTN.

*Shorea robusta* (the Sal tree) is a resin-yielding timber plant, growing commonly in the Sub-Himalayan Belt and in Central India. Gamble<sup>1</sup> records it in the Eastern Ghats of South India. Unicellular hairs are present on the floral parts and on the prolonged connectives of the anthers (Figs. 1, 2). The anther wall shows an epidermis, endothecium, three middle layers and a glandular binucleate tapetum (Fig. 3). The endothecium is not prominent and is non-fibrillar. Quadripartition of the microsporocytes takes place by centripetal furrowing resulting in tetrahedral (Fig. 4), isobilateral, and decussate quartets (Fig. 5) of microspores. The tricolpate pollen grains are two-celled at the time of shedding.

The tricarpeal ovary is superior, trilocular, with one or two anatropous, bitegmic, crassinucellate ovules in each locule attached on the central placenta. The micropyle is organised only by the inner integument. The hypodermal archesporium divides forming an upper primary parietal cell and a lower megasporocyte (Fig. 6). The latter becomes deep-seated due to the formation of a parietal tissue. Linear and T-shaped (Fig. 7) quartets of megaspores are formed. The chalazal megaspore alone functions, while the three others degenerate. The functioning megaspore undergoes three more divisions and gives rise to an octonucleate embryo sac of the Polygonum type (Figs. 8-10) as in *Shorea talura*,<sup>2</sup> *Hopea wightiana*,<sup>3</sup> and *Vateria indica*.<sup>4</sup> The antipodal cells are situated at the narrow chalazal end of the embryo sac and the polars usually meet in the centre.

After fertilisation the antipodals degenerate, and the embryo sac becomes elongated. The primary endosperm nucleus divides forming free nuclei. Some of them aggregate in a dense cytoplasm in the chalazal region of the embryo sac. The endosperm finally becomes cellular; cytokinesis being initiated from the micropylar end and extending towards chalaza



FIGS. 1-14. *Shorea robusta*. Fig. 1. Stamen, note the hairs on the prolonged connective,  $\times 25$ . Fig. 2. Tip of the connective enlarged,  $\times 100$ . Fig. 3. T.S. of anther wall,  $\times 500$ . Figs. 4-5. Tetrahedral and decussate tetrads,  $\times 1,500$ . Fig. 6. Megaspore mother cell and two parietal cells,  $\times 500$ . Fig. 7. T-shaped tetrad,  $\times 750$ . Figs. 8, 9. Two and four nucleate embryo sacs,  $\times 750$ . Fig. 10. Mature embryo sac,  $\times 750$ . Figs. 11-14. Stages in the development of the embryo,  $\times 500$ .

The fertilized egg undergoes a very belated transverse division resulting in a two-celled embryo (Fig. 11). Vertical walls are laid down in both these cells and a globular tetrad is formed (Fig. 12). Further divisions follow the same pattern as in *Shorea talura* and a mature embryo is formed. The mature dicotyledonous embryo has a prominent radicle and two fleshy unequal cotyledons, one enclosing the other. Seed-coat is formed by both the integuments. The one-seeded indehiscent fruit is enveloped by the accrescent sepals, which develop into wings.

I am thankful to Prof. K. N. Narayan for kind encouragement and interest, and to Dr. K. Subramanyam, for helpful suggestions. I am indebted to the authorities of the Mysore University for the award of a research fellowship.

Dept. of Botany, A. NAGARAJA RAO.  
Central College,  
Bangalore-1, March 18, 1956.

#### A NEW GENUS OF INDIAN ITONIDI- DAE:—*KITTADA COIMBATORENSIS*, GEN. ET SP. NOV.

RAO<sup>1</sup> has reported about 121 genera under Oriental Itonididae, as occurring in India. The broad characters of the family are: minute delicate flies with long antennae adorned with conspicuous whorls of hair; wings with few longitudinal veins; coxae not elongate; tibiae devoid of spurs. A new genus *Kattada* reported below was found on spontaneous rust (*Puccinia kuehni*). This new Diptera has been named as *Kittada coimbatorensis* (gen et sp. nov.) from the Sanskrit word *Kitta*=rust, *ada*=eating and *coimbatorensis* since it was collected, for the first time, from Coimbatore. The description of the same is as follows: Family—Itonididae, Subfamily—Itonididinae, Tribe—Itonididinae, Subtribe—Trifla.

*Kittada coimbatorensis* gen. et sp. nov. is a minute insect with an extremely delicate and fragile structure. Wing expanse 2.4-3.4 mm. The body is clothed with hairs. The antennae are long and adorned with conspicuous whorls of simple circumfila. Eyes confluent above and ocelli are wanting. Wings big and broader, spotted by small hair, wing-veins greatly

1. Gamble, J. S., *The Flora of the Presidency of Madras*, 1925, London.
2. Nagaraja Rao, A., *Phytomorphology*, 1953, 3, 476.
3. —, *Mys. Univ. J.*, 1955, 15, 519.
4. —, *Proc. Nat. Inst. Sci. India*, in press.

reduced (3 veins only). The legs are slender and quite long, the coxæ are not greatly elongated; tibiae without spurs, metatarsus shorter than the following segment; tarsi 5-jointed with a pair of simple, stout, dark-brownish simple claws; pulvillus not distinct but distal tibial end thickly setose. Palpi 4-jointed; the first segment with a length nearly twice its diameter, oblong, sparsely haired, the 2nd and 3rd of equal sizes, the 4th comparatively small and subquadrate.

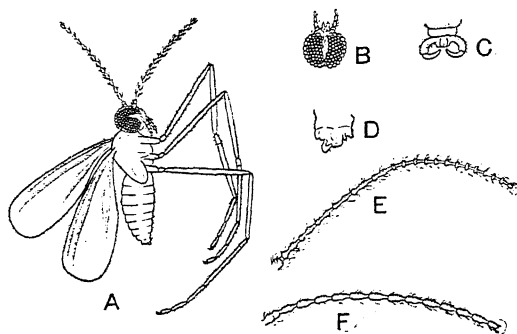


FIG. 1. (A) *Kittada coimbatorensis*, gen. et sp. nov.; (B) Mouth parts; (C) Male genitalia; (D) Female genitalia; (E) Male antenna; (F) Female antenna.

**Male.**—Length 0.9 mm. Antennae about  $1\frac{1}{2}$  times longer than the body, the first segment subglobose and second globose, 26-segmented, flagellate greatly produced and alternately binodose, global joints of the flagellate shortens

after 14th segment, distal segment small and hairy, simple circumfila occur on each segment. Mesonotum dark brown, abdomen uniformly brown. Basal clasp segment rather short and narrow, apically with a distinct lobe, terminal clasp segment rather long, scarcely swollen near the middle and apically with a stout, somewhat recurved chitinous spur.

**Female.**—Length 1.2 mm. General colour of the body uniformly brown. The antennae 15-segmented and slightly bigger than the body. The 1st segment subglobose and 2nd globose, the 12 segments of the flagellate long and cylindrical, the terminal segment short and narrowly pointed; circumfili small and simple. The ovipositor small, asymmetrically bilobed and distinct.

**Habit.**—Mycophagous; **Habitat.**—South India, Coimbatore, 7-11-1955. On Sugarcane; **Holotype.**—♂ and ♀ with the National Collection, I.A.R.I., New Delhi. Paratype (4—♂ and ♀) in collections of the Entomology Section at Sugarcane Breeding Institute, Coimbatore.

Grateful thanks are due to Shri N. L. Dutt for encouragement during the course of these studies, and to the Commonwealth Institute of Entomology for kindly declaring it a new genus and new species.

Sugarcane Breeding Inst., R. A. AGARWAL.  
Coimbatore, March 2, 1956.

1. Rao, S. N., *J. Res. Agr. Univ.*, 1955, 4, 213.

## RELEASE OF ENERGY FROM THE ATMOSPHERE AT HIGH ALTITUDES

SCIENTISTS at the Holloman Air Development Centre in New Mexico have found that nitric oxide has the property of bringing two oxygen atoms together to form an oxygen molecule and release the energy from sunlight which has been "chemically stored" in atomic oxygen high up in the earth's atmosphere. To test the laboratory discovery, a rocket was fired 60 miles up into the atmosphere where it released nitric oxide gas under high pressure. A flood of light resulted. In fewer than ten minutes the light had grown in size so that it appeared from the earth to be about four times the moon's diameter. The spot of light spread to about 3 miles in width before the gas thinned out and the brightness dimmed.

Several suggestions have been made about chemical reactions in which nitric oxide, present naturally in the upper atmosphere, might take part. One of these is the interaction with oxygen atoms mentioned above. A cyclic series of reactions has been proposed, in which the nitric oxide is regenerated. In that way the presence of a comparatively small quantity of nitric oxide could lead to a continuous emission of light and it is believed that further experiments on these lines may lead to a means of extracting this stored energy for such uses as the propulsion of rocket ships high in the atmosphere.

## REVIEWS

**High Energy Nuclear Physics.** (*Proceedings of the Fifth Annual Rochester Conference.*) Compiled and Edited by H. P. Noyes, E. M. Hainer, G. Yekutieli and B. J. Raz. (Interscience Publishers), 1955. Pp. 197. Price \$2.50.

The situation in high energy physics undergoes a thorough and critical survey at the Annual Rochester Conferences and their proceedings are therefore eagerly awaited by all workers in this field. The present proceedings are divided into eight sessions: (1) Low Energy Pion Phenomena; (2) High Energy Pion Phenomena; (3) Theoretical Physics; (4 & 5) Elementary Particles; (6) Elastic Scattering of Nucleons; (7) Accelerator Physics; and, finally, (8) A Summary Session. Most sessions are introduced by brief surveys. In view of the wealth of material discussed, one can mention only a few of the important presentations.

One of the main advances in meson physics was the first clear evidence, coming from Coulomb interference at small angles, that the signs of the pion-nucleon phase-shifts were what one had always supposed them to be, and that therefore the major interaction in the  $3/2-3/2$  state was attractive. The discrepancies in the low energy behaviour of the S-wave phase-shifts arising from different experiments were discussed, and Bethe suggested a remeasurement of all the experimental numbers involved.

Chew and Low presented the results of some investigations on pion-nucleon scattering and photo-meson production, based on a new and promising approach due to Low. Low sets up the scattering problem in terms of the wave-functions of the physical particles rather than those of the "Bare" particles, as is done in the Tamm-Dancoff method. Though the resulting integral equation has again to be cut off after the one-meson term, this seems to be an improvement over the corresponding Tamm-Dancoff approximation.

Williams has analysed cosmic-ray data to get a nucleon-nucleon total cross-section of  $\sim 120$  mb at high energies ( $\sim 30$  Bev). This is much larger than "geometric".

No new decay modes of the heavy unstable particles were reported but more instances of known modes, with better determinations of Q-values, masses and life-times, were presented. It is interesting to note, however, that at

the time of the conference, it was still not possible (as it is now) to conclude that there is no distinction between the various K-particles as regards mass, life-time, and associated production, and that they, therefore, very probably represent different decay modes of the same particles. On the theoretical side, the selection rules have been clearly formulated by Pais in terms of the isotopic spin, but the new quantum number, "strangeness" has not made its appearance.

B. M. UDGAONKAR.

**The Sources of Eddington's Philosophy.** By Herbert Dingle. (Cambridge University Press), 1954. Pp. 64. Price 3 sh. 6 d. (Paper cover.)

While philosophy has always had a profound influence on the development of scientific thought, it is only in the present century, mainly as a result of the theory of relativity and of quantum mechanics, that scientific ideas have started to influence philosophy. It is no wonder therefore that some of the foremost scientists have paid a great deal of attention particularly in their later years, to the philosophical implications of scientific discoveries.

Foremost among those who sought to interpret this aspect of science was Sir Arthur Eddington. It was he who brought out clearly that the theory of relativity required not merely big changes in many of the theories in physics, but a complete reorientation of the objectives of scientific method. The view that physics is the description of the character of the external world was simply no longer tenable. In his view, physics is the result of certain operations performed by the observer, and therefore is necessarily subjective in nature. Thus, instead of starting with a given unknown world and finding out its nature and character by observation, we start with observations and construct a world to satisfy them. However, as Dingle points out, Eddington was far too much of a Victorian to concede that there was no relation between physical quantities and the world, so he made the only possible assumption: physical quantities *symbolise* the world in some way.

Consequently, in Eddington's philosophy, there is a marked division between what might be called the *nature* and the *structure* of the



external world. All metrical studies give us information only about its *structure*, which because of relativity, is apprehended only in subjective form. However, there seems to be no limitations imposed on our knowledge of the external world obtained by non-metrical methods, adopted for instance by the artist or the theologian. Thus, the purely objective world is the spiritual world, consisting of life, consciousness, spirit; the material world is subjective in the sense of subjective selectivism.

An aspect of Eddington's philosophy which has caused more controversy than any other is his conclusion that the laws of physics are derivable by pure reason. But as Dingle points out (pp. 42-44), a good part of it is due to a misunderstanding of Eddington's writings. Eddington "distinguishes sharply between the laws of physics and the *actual entities* among which we find ourselves and which obey those laws.... The laws of physics characterise the behaviour of any conceivable physical world and therefore tell you nothing at all about which of the conceivable ones is the actual one." Further, when Eddington says that the properties of external world are deducible from pure reason, he means really the metrical world constructed from our data of observations. Eddington in fact claimed to have done this and obtained a theory unifying relativity and quantum theory, from which he could even deduce the numerical values of a number of fundamental constants.

It is not possible to summarize here all the ideas put forward in this fascinating critical review of Eddington's philosophy. Although terse and at places highly individualistic, the book can be warmly recommended to any one interested in the subject, as it contains one of the clearest expositions of Eddington's scientific philosophy.

#### Introduction to Atomic and Nuclear Physics.

Third Edition. By Henry Semat. (Chapman & Hall), 1954. Pp. xii + 561. Price 50 sh.

Ever since its appearance in 1939, Professor Semat's *Introduction to Atomic Physics* has enjoyed immense popularity with undergraduates and lecturers alike. Written by a teacher of modern physics with several years' experience, the book sets forth in simple and precise language all the essential details of atomic physics, with profuse illustrations and typical problems. Its revision in 1946, particularly in the section on nuclear physics, increased its usefulness considerably. And now

we have a completely revised and enlarged edition of the book, with the title modified to read, "Introduction to Atomic and Nuclear Physics".

Though the change in the title indicates the direction in which the major expansion has proceeded, yet one notices new additions to the text here and there, almost throughout the book. An important feature of this volume (as in earlier editions) that gives it added value as a text-book is the inclusion of a number of problems at the end of each chapter. Several new problems and a short bibliography are included at the end of each chapter of this volume. However, it is a pity that the references are mostly confined to other books, and very few references are made to original papers. At the Honours undergraduate level, at least the more enterprising students should be given an opportunity to refer to original papers on some of the important topics dealt with in the text.

The text has been divided into three major parts, viz., Foundations of Atomic and Nuclear Physics, Extra Nuclear Structure of the Atom and Nuclear Physics. But within these major divisions the chapter subdivisions follow the same general arrangement as in the earlier editions, except that some of the longer chapters have been further subdivided and new sections are added here and there. Some of the important additions to the first part include photo-multipliers, scintillation counters, Cerenkov radiation, wave velocity and group velocity, diffraction of neutrons and electron optics, accompanied by reproductions of electron micrographs. A very valuable addition to the second part is the section on nuclear magnetic moments, describing in some detail methods for the determination of nuclear magnetic moments.

Naturally, the third part of the book contains most of the new additions. Several important nuclear reactions, accompanied by cloud chamber and other photographs, nuclear energy level diagrams and yield curves have been added. Theories of alpha- and beta-decay, as well as evidence for the existence of the neutrino are presented and discussed. A whole chapter is devoted to nuclear fission, and all the different aspects are dealt with in full. Cosmic rays have again received scanty attention, as in former editions; but ample amends have been made by describing in some detail the new fundamental particles—the light and heavy mesons and hyperons—all of which were

discovered in cosmic ray studies. The section devoted to primary cosmic ray particles includes some very good photomicrographs of two large "stars" and a heavy primary track, illustrating meson jets, pi-mu-e decays and other interesting events. Particle accelerators are fully described in a separate chapter, and details about some of the recent (1954) giant accelerators are given, with photographs and sectional diagrams.

Here is a text-book for the undergraduate student in physics, the usefulness of which has been clearly demonstrated in the first two editions, and which is now presented to us with its value vastly enhanced by revision and enlargement. It is one of those text-books that ought to find a place in every college library where a degree course in physics is offered.

M. A. THANGARAJ.

**Heterocyclic Compounds with Indole and Carbazole Systems—Chemistry of Heterocyclic Compounds. Vol. VIII.** By W. C. Sumpster and F. N. Miller. (Consulting Editor: Weissberger.) (Interscience Publishers), 1954. Pp. 307. Price \$10.00.

As the Preface states, the chemistry of indole had its beginning in the dye industry, and for many years developments in the field were associated with dyes. Extensive accounts of the chemistry of indigo and its derivatives, and also of intermediates and related compounds such as indoxyl and isatin, have therefore appeared in books on the chemistry and technology of dyes. Consequently, one may question the purpose of several of the chapters in the book under review, which incidentally makes no reference to Thorpe and Ingold's *Vat Colours* (1923), Martinet's *Matieres Colorantes des Indigoides* (1934), and more recent publications in the field. Volume 3 of Elderfield's *Heterocyclic Compounds* (Wiley, 1952) has a chapter of 274 pages on indole and its derivatives, including indoxyl, oxindole, isatin, dioxindole, and indigo, and a chapter of 51 pages on carbazole. All these are treated, less satisfactorily on the whole, in the present book. The Elderfield Volume also deals with isoindoles, which are excluded from this volume of the Weissberger series. Excellent chapters on the indole alkaloids (by Marion) and the strychnos alkaloids (by Holmes) have appeared in the Manske-Holmes series covering the alkaloids, and it is doubtful if the present treatment of the same subjects offers any advantage. The chapter on carbazole is not comprehensive and up to date; thus useful information in BIOS

reports and other publications on the isolation of pure carbazole from anthracene oil and the preparation of various carbazole intermediates and dyes (e.g., Hydron Blue) has been ignored. The statements in p. 92 concerning carbazole tetrasulphonic acid neglect the fact that 2-hydroxycarbazole is manufactured from the mixed tetrasulphonic acids.

A methyl group has been omitted from structure (XXXIX) for vomicine (p. 271). In p. 20, line 1, "a, a" should be "a,  $\beta$ ". There are several errors in the spelling of names, e.g., Seshadre and Tilac.

This is a somewhat disappointing book, and it is too highly priced considering its size and the fact that the contents are largely a duplication of material readily available and more fully treated in other books.

K. V.

**The Law and the Engineer.** By Christopher F. Mayson. (Chapman & Hall), 1955. Pp. 470. Price 63 sh.

Several surveys regarding the faculties required to be developed in the engineer have revealed very interesting results; for instance, the following: "Essential Qualities of a Successful Engineer": 41% character, 17.5% judgment, 14.5% efficiency, 14% understanding of human nature and 13% *technical knowledge* (Charles R. Gow, *Foundations of Human Engineering*). An increasingly important part of an engineer has now come to be managerial abilities and so in an evergrowing manner Industrial Economics is included as part of the equipment for final Engineering Degree courses. Thus, in actual day-to-day practice of the profession as a builder, or a factory manager, or contractor or a technician-cum-administrator, the engineer also comes up against law and its many interpretations. The book under review is intended to "present to engineers in a practical and understandable manner certain aspects of law as are likely to be of interest and concern to those engaged in the design, manufacture, sale, installation and maintenance and repairs of engineering equipment" in England. It is not a handbook of reference like *Every Engineer: His Own Lawyer*; for, more than describing the legal framework the author is at pains to explain the aspects of law affecting the engineer so as to inculcate a general knowledge of the legal principles involved. For this the author has an advantage over other writers of such works, since Christopher Mayson practised as an engineer before he

studied law and went to the Lincoln's Inn as a barrister.

The book starts with an explanation of the scope and machinery of the civil law, the meaning and forms of evidence and goes on to a discussion of the formation, performance and breach of contracts. It deals with the Agency, Bailments, Agreements and other forms of contract, including Monopoly and Trade Alliances. Finally, in the sphere of management, it takes up the Law of Negligence, Factory Acts and Regulations and Employers' responsibilities and liabilities. Useful appendices are given on: (1) Responsibility of professional engineers, (2) Standard conditions of engineering contracts, (3) Summaries of the Factory Act, Statutory Regulations and Acts of Parliament and a table of cases. For all these reasons Indian readers too will undoubtedly find the work informative and helpful. As stated by Lord Justice Denning in his Foreword: It should "give the engineers sufficient knowledge of law to be able to deal with simple points and even more important to know when they should seek expert legal advice".

M. C. MUNSHI.

#### Recent Progress in Hormone Research, Vol. XI.

Edited by Gregory Pincus. (Academic Press, New York), 1955. Pp. viii + 518. Price \$10.00.

The eleventh volume of the *Recent Progress in Hormone Research* is a record of the Proceedings of the Eleventh Laurentian Hormone Conference held at Mont Tremblant, Quebec, in 1954, and maintains the high standard set by the first ten volumes of this series. The verbatim transcription of the critical discussions at the end of each chapter, gives a realistic account of the Conference, especially for those who were not present at those meetings.

The fourteen chapters are grouped into the following six sections: (i) Pituitary Hormones, (ii) Steroid Chemistry and Biochemistry, (iii) Hormones and Abnormal Growth, (iv) Hormones and Aging in Man; (v) Mechanism of Hormone Action, and (vi) Hormone Cardiovascular Interrelations. The section relating to hormone and aging in man will be of particular interest to medical men and clinical biochemists since geriatrics has assumed as much importance as pediatrics as a medical subject. This section consists of two papers, one on 'Aspects of Aging as Reflected in the Human Ovary and Testis' by E. T. Engle and the other on 'Steroid Metabolism in Aging Men and Women' by G. Pincus and others. The short

review by Engle followed by a lengthy discussion gives a good appraisal of the available histological data on the subject. Pincus and his colleagues give a summary of their earlier work, where they have studied the excretion of different urinary steroids in a group of normal healthy men and women. The changes in individual urinary steroids with age have been studied in great detail and the data fully discussed. They have also studied the influence of steroid replacement therapy on the urinary 17-ketosteroid patterns in old age.

In the section on hormones and abnormal growth, the pathogenesis and character of different hormones secreting transplantable pituitary tumours in mice have been described by Jacob Furth, while Raouson and Rall present a review of studies on certain endocrine factors that appear to control the growth of cancer of breast, tumours of the uterus, carcinoma of the prostate, lymphomatous tumours and tumours of the thyroid.

The section on hormone cardiovascular interrelations is also of considerable clinical interest. The dietary and hormonal factors in experimental atherogenesis and blood pressure regulation have been investigated by Stamler and others with encouraging results especially with regard to the role of estrogens in preventing recurrences of myocardial infarctions. The interesting paper on the two new hepatorenal vasoactive principles, VEM and VDM by Shorr and others deals with their tissues of origin and their intermediary metabolism. Also, the details have been given of the isolation and identification of VDM, its biological actions and of studies on factors involved in maintaining the integrity of the renal VEM and hepatic VDM systems.

Among other articles the recent progress in methods of isolation, chemistry and physiology of aldosterone has been well described by Simpson and Tait. A detailed paper on the role of micro-organisms in bringing about transformation of available steroids into desired cortical hormones has also been ably presented by Fried and his co-workers. Further, the two papers in the section on mechanism of hormone action deal mainly with insulin and carbohydrate metabolism.

There is included in the end, a useful cumulative index for the first ten volumes of this series. The volume on the whole is very well got up and should prove extremely useful to every biochemist and medical research worker who is interested in the progress of hormone research.

V. SRINIVASAN.

P. S. SARMA.

*Advances in Enzymology*, Vol. XVI. Edited by F. F. Nord. (Interscience Publishers), 1955. Pp. 584. Price \$11.0.

The present volume contains eight articles with cumulative author- and subject-index for volumes one to sixteen. The first article by J. Baddily contains a review of the isolation and the structure of co-enzyme A established by chemical, enzymic and microbiological methods. The next article on the coagulation of blood, written by W. H. Seegers, presents the facts about the various components taking part in the coagulation of blood in the clearest possible manner. H. S. Mason discusses the comparative biochemistry of the phenolase complex and its role in the formation of flower pigments, flavanoids, lacs, tannins, alkaloids, melanins and lignins. A comprehensive account of the transamination reactions and of the mechanism and role of transamination in amino acid metabolism, presented by A. Meister, will demand and repay the reader's earnest attention. In the article on "Intermediates in Amino Acid Biosynthesis" contributed by B. D. Davis, the author has discussed the role of a large number of intermediates and the enzymes in the biosynthesis of  $\alpha$ -amino acids. A thoughtful article on "Myosin" by Szent-Gyorgyi, provides a complete survey of the structural and functional aspects of myosin. The article on " $\beta$ -glucuronidase" contributed by W. H. Fishman sets out the distribution and properties of mammalian, bacterial, plant, insect and mollusc  $\beta$ -glucuronidase followed by a discussion in detail on the facts concerning its histochemistry, and the role of the enzyme in physiology and in relation to disease. The volume concludes with an article on the chemistry of the cell nucleus contributed by Allfrey, Mirsky and Stern, in which the authors have presented a critical survey of the procedures used in these investigations and a detailed account of the nucleic acids, proteins and enzymes of the nucleus.

The articles written by leading workers in their fields cover subjects of considerable topical interest on which adequate reviews for the general reader are not readily available. The contributors are to be congratulated on the careful sifting of material and clarity of exposition. The publishers have fully maintained their reputation for the excellence of printing and production. The book can be warmly recommended to all enzymologists, biochemists and those interested in these subjects.

K. V. GIRI.

## Books Received

*Advances in Carbohydrate Chemistry*, Vol. X. Edited by Melville L. Wolfrom and R. Stuart Tipson. (Academic Press), 1955. Pp. xx + 437. Price \$10.50.

*Advances in Veterinary Science*, Vol. II. By C. A. Brandly and E. L. Jungherr. (Academic Press), 1955. Pp. xii + 449. Price \$10.00.

*Society of Biological Chemists, India—Silver Jubilee Souvenir*, 1955. (Published by the Society of Biological Chemists, India), 1955. Pp. vii + 262.

*Recent Research on Vitamins*. (Medical Dept. The British Council, 65, Davies Street, London W. 1), 1956. *British Medical Bulletin*, Vol. XII. Pp. 90. Price 15 sh.

*Iron Ores of India*. By M. S. Krishnan. Indian Association for the Cultivation of Science, Calcutta-32), 1955. Pp. 177. Price Rs. 5.

*Methods in Enzymology*, Vol. II. Edited by S. P. Colowick and N. O. Kaplan. (Academic Press), 1955. Pp. xx + 987. Price \$23.80.

*A Symposium on Inorganic Nitrogen Metabolism: Function of Metallo-flavoproteins*. Edited by William D. McElory and Bently Glass. (The Johns Hopkins Press, Baltimore-18, U.S.A.), 1956. Pp. xi + 728. Price \$10.00.

*Advances in Protein Chemistry*, Vol. X. Edited by M. L. Anson, Kenneth Bailey and John T. Edsall. (Academic Press), 1956. Pp. viii + 425. Price \$9.00.

*Thermodynamics and Statistical Mechanics—Lectures on Theoretical Physics*, Vol. V. By Arnold Sommerfeld. (Academic Press), 1956. Pp. xviii + 401. Price \$7.00.

*Polymyxin, Neomycin and Bacitracin—Antibiotics Monographs*, No. 5. By Ernest Jawetz. (Interscience Publishers), 1956. Pp. 96. Price \$4.0.

*Kernmomente*. Second Edition. By H. Kopfermann. (Akademische Verlagsgesellschaft mb, Frankfurt am Main), 1956. Pp. xvi + 463. Price DM 54.

*Non-Ferrous Metal Industry in Europe*. (Organisation for European Economic Co-operation, 2, rue Andre-Pascal, Paris-16<sup>e</sup>). Pp. 92. Price \$1.00.

*Reduction with Complex Metal Hydrides*. By Norman G. Gaylard. (Interscience Pub.), 1956. Pp. xvi + 1,046. Price \$15.00.

*Polymer Processes—High Polymers*, Vol. X. Edited by C. E. Schildknecht. (Interscience Pub.), 1956. Pp. xvii + 914. Price \$19.50.

## APPLIED BIOLOGY\*

THE volume of the journal, under review, is the Proceedings of the Silver Jubilee Meeting of the Association of Applied Biologists held in London during September 1954. It contains 39 articles devoted to various aspects of the biological sciences. These articles have been classified under eleven heads.

Among the articles of general interest is one by Sir John Russell on "The Changing Problems of Applied Biology". Sir John Russell has pleaded for close co-operation between the specialists of all branches of biology. He has dealt with the prodigious developments in the various sciences like development of synthetic chemical industry, systematic insecticides and fungicides, antibiotics, growth-promoting substances, etc. He rightly states that "these new substances, the new insecticides, fungicides, plant hormones, herbicides and others give great powers of control but they also raise a host of new problems". The modern applied biologist is a specialist dependent on the statistician, the chemist, the physicist and others for a proper understanding of this intricate problems. Specialisation leading to lack of proper co-ordination of the different branches is likely to hamper advancement. The Jubilee Meeting of the Association has pre-eminently served the purpose of bringing together outstanding specialists in the different branches of Applied Biology.

The need for International co-operation in combating plant diseases and pests has been forcibly brought out in the three articles under the heading "International Co-operation in the Field of Crop Protection". A strong plea to avoid overlapping of the activities of the different commissions sponsored by UNESCO, E.P.P.O., F.A.O., W.H.O., etc., has been made for a more efficient working of the International Crop Protection Schemes.

The three articles on the problems of food storage and insect pests of stored products deal with the importance of proper storage conditions not only for the good of the farmer, but also for a sound national economy. Stress is laid and correctly on the fact that the prestige of a nation is likely to be lowered through marketing insect damaged foodgrains.

A review of the research work so far done on plant virus diseases and their spread and control has been brought out in the four arti-

cles dealing with plant viruses and virus research. The electron microscope has enabled us to see and study the viruses which for so long have been invisible and rapid advances have been made in the study of plant virus. Yet much work remains to be done on the exact mechanism of virus multiplication in the cell. Plant breeders have played an important part in the evolution of virus-resistant strains. More recently 'tissue culture' has afforded a promising way of obtaining virus-free plants from infected stocks.

Considerable advance has been made in the field of plant hormones and selective weedicides. Ever since the identification of indole acetic acid as a plant auxin, a number of synthetic compounds have been introduced into the market. These substances have been of use in rooting of cuttings, inhibition of bud growth, initiation of parthenocarpic fruit production, for prevention of the drop of immature fruit, for acceleration of flowering of pineapples and for weed control. The most modern hormone which seems to act as a panacea for all ills is 2-4-D. There are four interesting articles on this aspect.

The need for education and training in applied biology has been forcibly brought out in the three articles relating to "Education and Extension Services in Applied Biology". This subject has been discussed by the President, Prof. Brown, himself. The lower status given to the research worker in applied science as compared to his counterpart in pure science has been strongly deplored. The correct approach to biological education for agricultural research has been well discussed by Prof. Brown.

Problems of applied zoology, especially biological control of insect pests, have been discussed in three articles. Taylor has ably summarised the various aspects of biological control and summarises in the end that it is the best of all methods of controlling pests but seldom works, and there is little future for it in continental areas. It is to be considered whether in these days of chemical control methods, the biological control, with its limited scope, is really comparable with the former in efficacy and cheapness.

The volume covering all aspects of applied biology brings out clearly the complexity of any biological problem and the need for co-ordination of different branches for their solution.

N. L. DUTT.

\* *The Annals of Applied Biology* (Vol. 42) (Cambridge Univ. Press), 1955. Pp. ix+414. Price 25 s/h.

## SCIENCE NOTES AND NEWS

### Zonate Leaf-spot Disease of Jowar

R. K. Singh and H. H. Prasad, Central Sugarcane Research Station, Pusa, Bihar, write that during September 1955, leaves of six varieties of *Sorghum*, namely, MM 9, MN 48, Rex, Sart, *Sorgo* strain C-041 and *Sorgo* strain R 615 varieties were found to suffer from zonate leaf-spots caused by *Glæocercospora sorghi* Bain and Edgerton, the incidence of the disease being 1.0-45.0% on plant basis. Previously the disease has been reported from U.P. (R. K. Singh, *Thesis*, Agra 1948) on *jowar* and from United States [D. C. Bain and E. W. Edgerton, *Phytopath.*, 1942, 32, 1; 1943, 33, 220] on *Sorghum*, maize and sugarcane, etc. The filiform spores formed in spots and in culture measured  $28.5-89.1\mu$  (average  $54.1\mu$ ) in length and  $1.8-2.8\mu$  (average  $2.3\mu$ ) in breadth. This is the first record of the disease from Bihar.

### Expanding Universe

The theory of the expansion of the universe rests observationally on Hubble's law, which shows that galaxies in space are receding from each other with velocities that are proportional to their distances apart. Evidence for this red shift law rests on observations obtained only in the narrow visible portion of the wide electromagnetic radiation spectrum that impinges on the earth's atmosphere.

The observed red shifts have been attributed to Doppler effect, in which case the wavelength shift divided by the wavelength used should be constant anywhere in the electromagnetic spectrum. The spectral line at a wavelength of 21 cm. (arising from hydrogen gas in interstellar space) offers a test for this interpretation. Hydrogen absorption measurements carried out by Lilley and McClain on the Cygnus source establish the constancy of the red shift over a base line of 50,000 to 1 in the electromagnetic spectrum. This constancy is a natural consequence of the Doppler interpretation giving it strong support.

### New Synthetic Hormone

John A. Hogg *et al.* have announced a new synthetic hormone nearly three times as potent as aldosterone (*J. Amer. Chem. Soc.*, 1955, December 25 issue). The new hormone is a methyl derivative of fluorohydrocortisone ace-

tate and is more effective than any other known substance in stimulating the body's retention of salt, an ability that is characteristic of some adrenal cortical hormones.

A second methyl hormone is also reported in the same article. This substance, named 2-methylhydrocortisone acetate, is ten times as active as hydrocortisone in the glycogen deposition assay.

### Technology of Fish Processing

An International Meeting of Fish Processing Technologists, organised by the FAO, is to take place at Rotterdam, Netherlands, from 25 to 29 June 1956, at the invitation of the Netherlands Government. The meeting will be open to any fishery technologist who wishes to attend.

Dr. G. A. Reay of the United Kingdom will be Chairman of the Meeting and the Chairman of the four committee working groups—Mr. F. Bramsnaes of Denmark, Mr. K. Bakken of Norway, Professor George Borgström of Sweden and Mr. E. Heen of Norway—will present their reports on chilling and freezing of fish, fisheries products for tropical consumption, and prepackaged fisheries products. A Symposium on the Chilling of Fish will be held during three days of the Meeting. The Symposium will deal with the use of antibiotics, bacteriostatic ices and dips, brine cooling, sea-water ice, scale and crushed ice, and fresh fish quality assessment, using organoleptic and objective methods.

Fishery technologists who wish to attend the meeting should notify the Secretary of the Interim Committee, Dr. Hess, Chief, Technology Branch, Fisheries Division, FAO, Rome.

### Endeavour Prizes

The Imperial Chemical Industries (Publishers of the quarterly scientific review *Endeavour*) have offered the sum of 100 guineas to be awarded as prizes for essays submitted on a scientific subject. The competition is restricted to those whose twenty-fifth birthday falls on or after 1st June 1956. The subjects for the essays are as follows: Research in Polar Regions; Scientific Aids to Archaeology; The Story of Steel-Making; The Chemistry of Big Molecules; New Elementary Particles; The Control of Plant Diseases. The essays, which must be in English and typewritten, should not exceed 4,000 words in length, and only one

entry is permitted from each competitor. Essays must be submitted without signature. The competitor's full name and address and date of birth should be disclosed in a sealed covering letter attached to the essay and addressed to: The Assistant Secretary, British Association for the Advancement of Science, Burlington House, Picadilly, London, W.1, and must be received before June 1, 1956.

#### European Federation of Chemical Engineering

The European Federation of Chemical Engineering was founded in 1953 and, at the moment, consists of 24 Member Societies from 13 different European countries. The Federation has been extremely active in the short period of its existence. The Federation held its First Congress in 1955 in Frankfurt am Main, which was attended by no less than 12,150 personally registered visitors from 53 different countries.

A further result of this close co-operation of technical and scientific societies in the chemical engineering and equipment fields is the careful co-ordination of forthcoming important events in this sphere of activities. Details of the events for 1956 are as follows: 7-8 June, 1956, Frankfurt am Main: 31st Annual Congress of the *Dechema*; 1-3 October, 1956; Hamburg: Annual Meeting of Process Engineers; 22-24 November, 1956, Paris: Symposium on Special Themes.

The organising bodies may be approached for all further details concerning the events and functions listed above.

Prof. G. B. B. M. Sutherland

Prof. G. B. B. M. Sutherland, Professor of Physics, and Director of the Biophysics Research Centre in the University of Michigan, has been appointed Director of the National Physical Laboratory, U.K. Prof. Sutherland is a leading authority on infra-red spectrum analysis but of recent years has taken special interest in the field of biophysics. In 1947 he became Reader in Spectroscopy at Cambridge and in 1949 was appointed to his present post in the University of Michigan. He was elected a Fellow of the Royal Society in 1949.

#### Madras University Prizes

The *Maharaja of Travancore-Curzon Prizes* for 1956-57.—Two prizes, one for Archæology and one for Bacteriology, will be awarded by the Syndicate for the best essay or thesis written by any graduate of the Madras University on any topic dealing with the subjects. The value of each prize is Rs. 250. Competitors

should submit their theses so as to be received by the Registrar not later than the 1st March 1957.

#### Sir William Wedderburn Prize, 1957.

The prize which will consist of books of the value of Rs. 45, will be awarded to the student, who, having qualified in chemistry for the Degree of B.Sc. (Honours) or M.Sc. not more than two years previously, has shown aptitude for research. A thesis on any research work conducted by the student should be submitted with the application so as to be received by the Registrar, University of Madras, not later than the 30th April 1957.

#### Directory of Aluminium, 1955

An attractively got-up brochure on Aluminium has been published by the India Section of the Electrochemical Society, Bangalore-3, under the editorship of Dr. N. R. Srinivasan. The brochure has three sections: The technical section comprises articles on various aspects of aluminium among which mention may be made of: The History of Aluminium, by V. Ramachandran and N. R. Srinivasan; A Perspective of the Indian Aluminium Industry, by Mahesh Chandra; Aluminium in Telecommunication Industry, by S. Krishnamurthy; Some Aspects of Aluminium Research in India, by E. G. Ramachandran. The reference section gives physical and chemical data which will be of much use to industrialists, as well as information on patents, standards and current researches on various aspects of the metal. The Directory Section contains the names and addresses of industrialists and manufacturers dealing with aluminium from the ore stage to the finished product.

The venture is a laudable one and deserves support from the Government, industry, trade, and research workers.

#### Award of Research Degree

The University of Bombay has awarded the D.Sc. Degree in Botany to Sri. V. S. Rao for his thesis entitled, "Studies in the Floral Anatomy and Floral Morphology of the *Bicarpellatae* and Some Other Families of Angiosperms".

The Nagpur University has awarded the D.Sc. Degree in Zoology to Dr. B. S. Chauhan for his thesis related to "Studies on Indian Fauna".

The Delhi University has awarded the Ph.D. Degree in Botany to Sri. R. Narayana, for his thesis entitled "Morphological and Embryological Studies in the Family *Loranthaceae-Loranthoideae*".

# Current Science

Vol. XXV]

MAY 1956

[No. 5

	PAGE		PAGE
<i>Prof. S. Chandrasekhar as Astrophysicist</i>	139	<i>Multiple Spot Phenomenon in Inorganic Circular Paper Chromatography—A. R. VASUDEVA MURTHY AND V. A. NARAYAN</i>	145
<i>Symposium on Crystallography—GOPINATH KARTHA</i> .. .. .	141	<i>The Training of University Teachers</i> ..	147
<i>Tuberculosis Vaccines</i> .. .. .	142	<i>Preparation of Illustrations for Publication</i>	147
<i>Mechanism of Selenium Dioxide Dehydrogenation of Flavanones—N. R. BANNERJEE AND T. R. SESHADRI</i> .. .. .	143	<i>Letters to the Editor</i> .. .. .	148
		<i>Reviews</i> .. .. .	169
		<i>Science Notes and News</i> .. .. .	173

## PROF. S. CHANDRASEKHAR AS ASTROPHYSICIST\*

PROF. CHANDRASEKHAR'S work as an astrophysicist is so fundamental in quality and pervasive in its range that it is difficult to present a summary of his work in the course of a single lecture. However, an attempt is being made here to indicate briefly the nature and extent of his contributions which make him one of the greatest astrophysicists of our age.

### STELLAR STRUCTURE

Violent nuclear collisions can result from thermal motion if a material is heated to a high temperature. The reaction  $\text{Li}^7 + \text{H}^1 = 2\text{He}^4$  can be observed at as low as 8 KeV thermal energy, that is, of the order of  $10^8^\circ \text{C}$ . In such a thermal nuclear reaction, every particle becomes a bombarding nucleus and therefore we have an isotropic bombarding of particles, of density comparable to that of the

material itself. Of course, it must be kept in mind that only the high energy tail of the Maxwell distribution contributes effectively to these reactions.

Whereas the temperatures necessary for such reactions even among the lightest elements are beyond any laboratory possibilities on earth, they are quite common in the cosmos and in fact, form the principal source of stellar energy. These reactions take place in the hot interior of the stars. Chandrasekhar's book on stellar structure relates to mathematical problems involving such physical conditions in stellar interiors. His work reveals the comparative simplicity of the theory of stellar structure due to the fact that at such high temperatures, the stellar material is completely ionised and forms an ionised gas. Hence the physical properties of such an ideal gas mixture of bare nuclei and nuclear electrons can be predicted with great accuracy. Particular mention must be made of Chandrasekhar's contribution to the structure of the red giant stars. He has shown on the basis of observational material that red

\* Abstract of lecture delivered by Dr. Alladi Ramakrishnan at the Presidency College, Madras, on the occasion of unveiling the portrait of Prof. S. Chandrasekhar (an old student of the College), by Dr. A. L. Mudaliar, Vice-Chancellor, University of Madras.



giants possess a much higher central condensation of material than normal stars of the main sequence. Whereas in a normal point source model 90% of the stellar mass occupies one half of the stellar radius, the red giants have the same mass condensed within 25% of the radius from the centre.

The study of white dwarfs presents a new aspect of the theory of matter of the super dense state. Chandrasekhar has made extensive calculations regarding the external ratio and the internal density distributions for degenerate white dwarf configurations of the various total masses and hydrogen content.

Chandrasekhar has also contributed to the theory of the origin of chemical elements and the explanations for abundance curves based on the hypothesis of dynamical equilibrium between various nuclear species at a certain high density and temperature. Among other workers in the field may be mentioned Weizsacker, Stern and Watagin. The entire work on stellar structure is embodied in two classic works—*Introduction to the Study of Stellar Structure*, 1939, and *Principles of Stellar Dynamics*, 1942.

#### RADIATIVE TRANSFER

Chandrasekhar can be reckoned to be one of the founders of the subject of radiative transfer. The scope of that work is best defined by quoting the excellent preface to his own book on that subject. "The problem of specifying radiation field in an atmosphere which scatters light in accordance with well-defined laws dates back to Lord Rayleigh's investigation in 1871 on the illumination and polarisation of the sunlit sky. But the fundamental equations governing Rayleigh's particular problem had to wait seventy-five years for their proper formulation and solution. The subject was given a fresh start under more tractable conditions when Arthur Schuster formulated in 1905 a problem in radiative transfer in an attempt to explain the appearance of absorption and emission lines in stellar spectra and Schwartzchild introduced in 1906 the concept of radiative equilibrium in stellar atmospheres. Since that time the subject of radiative transfer has been investigated principally by astrophysicists, though in recent years the subject has attracted the attention of physicists also, since essentially the same problems arise in the theory of the diffusion of neutrons."

Chandrasekhar's work on radiative transfer is embodied in his third and probably the most mathematical of his books. In this book he has attempted to present the subject of radiative

transfer in a plane parallel atmosphere as a branch of mathematical physics with its own characteristic methods and techniques. On the physical side the novelty of the methods used consists in the employment of certain general principles of invariance, which on the mathematical side leads to the systematic use of non-linear integral equations and the development of the theory of a special class of such equations. On these accounts the subject would seem to have an interest which is beyond that of the specialist alone: at any rate, that has been his justification for writing this book. However his own partiality had led him to include two chapters which are probably of interest only to the astrophysicist.

#### STATISTICAL ASTRONOMY

The third important field to which Chandrasekhar made his important contribution is "Stochastic Processes and Statistical Astronomy". In 1943, there appeared in the *Reviews of Modern Physics* one of the most important papers in the history of statistics. No single quasi-expository paper has attracted so much attention and has been quoted so often as that classic one on 'Stochastic Processes in Physics and Astronomy'. Perhaps it is permissible to say that here he forestalled the statistician in demonstrating the possibility of application of the abstract theory of stochastic processes to physical problems. It was only six years later that papers of a similar type appeared and that too from statisticians steeped in probability theory and not physicists. In 1950, with his collaborator G. Munch, Chandrasekhar started his work on statistical astronomy, with a series of papers 'On the Fluctuations of the Brightness in the Milky Way'. His interest soon turned to the theory of turbulence, a field made famous by men like Heisenberg, G. I. Taylor, Von Karman and Kolmogoroff.

Delivering the Henry Norris Russel lecture on 'Turbulence, a Physical Theory of Astrophysical Interest', he said, "I have chosen to describe to you the recent advances in our understanding of the phenomenon of turbulence in the belief that these advances are relevant to the progress of astrophysics. Perhaps, it is premature to take an occasion like this to describe a physical theory which is yet to establish its relations to astronomical developments. But the history of astronomy and astrophysics shows that major advances in our understanding of astrophysical phenomena have coincided with and depended upon advances in fundamentals of physical theory."

Chandrasekhar's prediction soon came true. Today, turbulence is playing a central role in the understanding of the structure of interstellar matter. Weizsacker has outlined a general cosmogony, the essential feature of which is the prominent role ascribed in the interplay of turbulence and rotation. Martin Schwartzchild has extended the Heisenberg theory of turbulence to include the agency maintaining turbulence for the case when the turbulence results from thermal instability. It has important applications in the interpretation of solar granules.

Chandrasekhar has turned his attention in recent years to the new and fascinating field involving the interplay of hydrodynamics, electromagnetic theory and turbulence. Even more recently, he associated himself with Fermi, in work on interstellar magnetic fields.

Finally, a few remarks about Chandrasekhar's

general attitude towards science and research may not come amiss. Chandrasekhar has preserved the two most lovable characteristics of the pure scientist, an unbending desire for freedom of thought and expression combined with quiet confidence. Any estimate of Chandrasekhar's contribution as an astrophysicist is incomplete if reference is not made to the great school of astrophysics he has created. Even a casual glance through the volumes of the *Astrophysical Journal* during the past twenty years will reveal that a considerable fraction has been stimulated by suggestions of Professor Chandrasekhar. He was made the Managing Editor of that famous Journal a few years ago. But the best tribute to a scientist is to attempt to emulate his example and pursue science with passion, humility and confidence, qualities which sum up the characteristic of a true student of science.

#### SYMPOSIUM ON CRYSTALLOGRAPHY

THE International Crystallographic Union held a symposium in Madrid from 2-7, April under the patronage of *Consejo Superior de Investigación Científicas*, Spain. The three topics discussed during the symposium were: (1) Structure on a scale between the atomic and microscopic domains, (2) Open Meeting of the Commission of Crystallographic Apparatus, and (3) On Crystallographic Teaching.

Prof. Wyckoff in his Presidential Address pointed out the scope and importance of the study of macromolecules by electron microscopic and X-ray methods and the valuable results these studies have yielded. He also stressed the necessity of discussing the methods of teaching employed in various centres of crystallographic study.

Over fifty papers were read on structural studies in the submicroscopic domain using X-ray as well as electron microscopic and electron diffraction techniques. Special mention may be made of the beautiful electron micrographs exhibited by Prof. Wyckoff having such a fine resolution as to show up even details within the molecule in shadowed replicas of macromolecular crystals. A large number of papers dealt with texture studies of metals and alloys as well as other substances of commercial interest like grease and coal. The small angle scattering from fibres and individual particles was the subject of a number of theoretical and experimental investigations. The correlation of the data revealed by X-ray diffraction and electron microscopy was also

discussed. The Commission for Crystallographic Apparatus discussed new apparatus and methods to tackle special crystallographic problems. Papers presented dealt with microfocus and rotating anode tubes, special cameras for single crystal counter diffractions, a miniature Weissenberg camera with a film radius 5 mm. and cameras for small angle scattering studies. Parrish stressed the advantages of using focusing monochromators for the X-ray diffractometer and also the superiority of scintillation counters with pulse height discriminator over the G-M counter in eliminating dead time effects, increasing quantum efficiency, producing higher peak to background ratio and in being capable of detecting even sulphur K radiation ( $5.5 \text{ \AA}$ ).

The session of the Commission on Crystallographic Teaching started with invited papers dealing with special aspects of teaching crystallography and was followed by a lively discussion. The opening paper was by Prof. Bernal on the 'History of the Present Status of Crystallographic Teaching'. The paper, "Lecture Demonstrations in Crystal Physics", by Prof. A. V. Shubnikov (U.S.S.R.) accompanied by beautiful short films clearly demonstrating the various aspects of crystal growth, simple models for dislocations and vacancies, etc., was one of the highlights of the session, and created very wide interest and discussion on the advantages of the use of motion picture demonstrations in explaining phenomena to students.

There were discussions regarding the type of courses that a student with a limited time at his disposal could advantageously undergo. The technique of teaching the subject, logical difficulties of comprehending the ideas involved in space groups and symmetries and the necessity of propaganda to create more widespread understanding of the capabilities of X-ray

crystallographic techniques were some of the other topics discussed.

At the closing session of the symposium the President expressed his gratitude to the patron for extending the invitation to the Union for holding the symposium in Madrid and for all the hospitality extended during the period.

GOPINATH KARTHA.

### TUBERCULOSIS VACCINES

IT is now more than thirty years since a live vaccine containing B.C.G. (*bacille Calmette-Guérin*) was first used in man. In the interval B.C.G. vaccination has come to be accepted in many countries as an effective method of preventing progressive tuberculosis, and it has been particularly widely used since 1945. In 1937 Wells discovered the mycobacterium of vole tuberculosis, and later explored the use of a live vaccine containing it. Vole-bacillus vaccine has since been used in a few countries, but on a very small scale compared with B.C.G. vaccine. Its value as a preventive measure has also not been fully assessed.

In July 1949, the British Medical Research Council, aware that a clinical trial of these two vaccines was needed to provide essential information, appointed a Tuberculosis Vaccines Clinical Trials Committee to plan and direct an appropriate investigation. The first report of this trial, which is still in progress, has been published in a recent issue of the *British Medical Journal* (February 25, 1956, p. 413).

During the two-and-a-half years after entry to the trial the total number of participants known to have died was 38. None of these deaths was due to tuberculosis, and there seemed to be more than chance differences between mortalities in the various groups. Among the vaccinated children 99.6% of those receiving B.C.G. and 94.4% of those receiving vole-bacillus vaccine became tuberculin-positive. However, the potency of the batch of vole-bacillus vaccine used in the earlier part of the trial was low, and of 1,900 who were vaccinated with the later batch all became positive reactors to tuberculin.

The children who have been under observation for a longer period up to four years, provide some further information. The intervals between entry to the trial and the earliest manifestation of tuberculosis in the unvaccinated negative reactors and in the positive reactors showed interesting differences. On the whole, in the groups of positive reactors the incidence of evident tuberculosis was fairly even over the first three years whereas among

the unvaccinated negative reactors the incidence during the first year was notably lower, and only during the second year reached approximately the same levels as those of the group showing high tuberculin sensitivity on entry. This can presumably be correlated with the fact that these children left school and started to run a greater risk of infection with tuberculosis within 6-12 months after entry to the trial. Another important point which this extended analysis shows is that the more favourable experience of the vaccinated children was maintained during the whole of the four years of observation.

This trial has shown beyond doubt the benefit of B.C.G. vaccination for adolescents in an urban industrialized community. The study of all participants, including those initially tuberculin-positive, has permitted an assessment of the benefit to be expected from routine B.C.G. vaccination in this particular group of subjects; the apparent reduction in the incidence of tuberculosis over the period of two-and-a-half years as a result of giving B.C.G. vaccine to all those initially tuberculin-negative would have been of the order of 35%. The high incidence of tuberculosis in those who were initially highly sensitive to tuberculin emphasizes the desirability of including in a scheme of B.C.G. vaccination provision for frequent re-examinations of this group. The question of the relative merits of vole-bacillus vaccine and B.C.G. is to be the subject of a further study. Certainly it appears at present that the vole-bacillus vaccine gives rise to a higher incidence of undesirable immediate effects.

Not enough is known at present to allow the prescription of an optimal age for vaccination, and if there is indeed such an age it may well vary with changing circumstances. The best compromise might be to offer vaccination to school children as a routine at the age of about 12—a little earlier than in the trial, since 40% of the participants were already infected on entry—and to make vaccination against tuberculosis conveniently available at any age to children whose parents request it.

## MECHANISM OF SELENIUM DIOXIDE DEHYDROGENATION OF FLAVANONES

N. R. BANNERJEE AND T. R. SESHADRI

*Dept. of Chemistry, University of Delhi, Delhi-8*

THE use of acetic anhydride as solvent for selenium dioxide dehydrogenation of flavanones has the advantage that the method can then be used for hydroxy compounds also. The preparation of diosmetin<sup>1</sup> and luteolin<sup>2</sup> from hesperidin by this method has already been reported. In the course of these experiments, the formation of a small amount of a by-product was noticed. The glycosides, hesperidin and naringin as well as the corresponding aglucones, hesperetin and naringenin have now been subjected to direct selenium dioxide oxidation in the presence of acetic anhydride and the products worked up in the same way; the glycosides underwent hydrolysis during the treatment with dilute sulphuric acid for deacetylation. In all these cases the corresponding flavones, diosmetin and apigenin were predominantly the major products which could be obtained pure by crystallisation. The accompanying by-products could be identified by paper chromatography to be the corresponding flavonols, namely, tamarixetin<sup>3</sup> and kempferol respectively. That this was not due to the presence of impurities in hesperidin and naringin obtained from natural sources as well as in the products of their hydrolysis, hesperetin and naringenin, was proved by the fact that each of them gave a single ring on filter-paper chromatogram.

### OXIDATION OF HESPERIDIN AND HESPERETIN

Selenium dioxide (1 g.) was boiled in acetic anhydride (25 c.c.) with either hesperidin<sup>2</sup> or hesperetin (1 g.) or either of their acetates<sup>1</sup> (2 g.) in an oil-bath at 155-65° for 6 hr. Metallic selenium was filtered off and the deep brown filtrate was poured on to crushed ice. The yellow solid was boiled with alcoholic sulphuric acid (7%; 50 c.c.) for 2 hr., diluted with water (50 c.c.) and extracted with ether and the ether solution evaporated. The brown residue crystallised from aqueous alcohol as yellow needles, m.p. 251-53°. Yield, about 60%. It had all the properties of diosmetin,<sup>4</sup> Rf 0.67 (acetic acid—water, 1:2, 25°, Whatman Filter-Paper No. 3); ring appeared after spraying with ammonia. The aqueous alcoholic mother liquors gave a yellow ring (Rf 0.49); on spraying with dilute ammonia another yellow ring (Rf 0.67) appeared. Two brown rings were formed on spraying with alcoholic ferric chloride (1%) instead of ammonia. Tamarixetin<sup>3</sup> gave a yellow ring (Rf 0.49)

and when it was mixed with the above mixture, a single yellow ring (Rf 0.49) appeared before spraying and another yellow ring (Rf 0.67) on spraying with dilute ammonia. An experiment with double the quantity of selenium dioxide did not appreciably increase the yield of flavonol.

### OXIDATION OF NARINGIN AND NARINGENIN

It was carried out exactly in the same manner and with the same proportions as in the above cases. The brownish yellow product obtained by hydrolysis was crystallised from aqueous alcohol when apigenin, m.p. and mixed m.p. 341-43° crystallised out. Yield, about 60%. The mother liquors revealed on filter-paper chromatogram a yellow ring, Rf and mixed Rf with kempferol (i) 0.35 (acetic acid—water, 1:3), and (ii) 0.81 (phenol—water, lower layer) without spraying. Spraying with aqueous ammonia revealed another yellow ring, Rf and mixed Rf with apigenin 0.48 (acetic acid—water, 1:3).

### OXIDATION OF 5:7-DIMETHOXY FLAVANONE

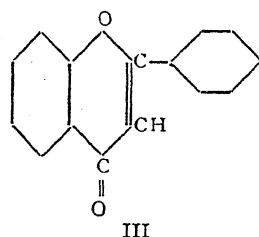
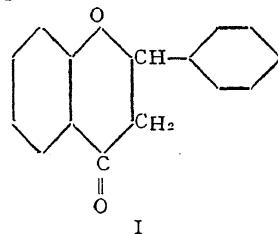
In all the above cases there was some difficulty of separating the hydroxy flavones and flavonols but this was expected to be got over by using 5:7-dimethoxy flavanone in which the resulting flavonol can be easily separated from the flavone using its solubility in alkali. Though the separation was effected it was noticed that the alkali-soluble portion contained two products, one agreeing with galangin 5:7-O-dimethyl ether and the other with 2-hydroxy-4:6-dimethoxy chalcone. The chalcone may have been produced by the opening up of the flavanone ring by the boiling acetic anhydride. The relevant particulars are given below.

The crude oxidation product from the flavanone (1 g.) was taken up in ether and repeatedly extracted with cold aqueous sodium hydroxide (5%). The residual ether extract yielded 5:7-dimethoxy flavone as colourless needles m.p. and mixed m.p. 149-50°. Yield 70%. The alkaline extract was acidified and extracted with ether. The residue obtained on evaporation gave two yellow rings Rf 0.49 and 0.92 on filter-paper chromatogram (acetic acid—water 1:3, solvent). On spraying with alcoholic ferric chloride (1%) they turned brown and reddish violet respectively. Mixed chromatography with galangin 5:7-O-dimethyl ether

(Rf 0.49) and 2-hydroxy-4: 6-dimethoxy chalcone (Rf 0.92) revealed no new rings.

#### MECHANISM OF DEHYDROGENATION

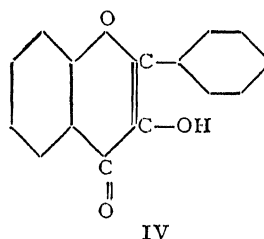
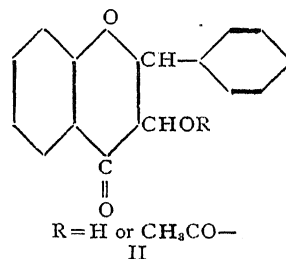
The yield of the flavonol in all these experiments is, however, very small and does not interfere in the preparation of the corresponding flavone in a pure condition; but its production is of significance in regard to the mechanism of selenium dioxide oxidation of flavanones. It was shown by Riley *et al.*,<sup>5</sup> that a methylene group as in cyclohexanone and a methyl group as in acetone located adjacent to an activating carbonyl can be oxidised by selenium dioxide to a CO and a CHO group respectively. Schwenk and Borgwardt<sup>6</sup> showed that even an ethylene group as in cyclohexene can activate the oxidation of the neighbouring CH<sub>2</sub> group to CO. Employing acetic anhydride or a mixture of the anhydride and the acid as solvent Guillemonat<sup>7</sup> was able to obtain in the case of cyclohexene and 2-methyl-2-butene the intermediate stage of a secondary and a primary alcohol respectively.



When two methylene groups are associated with activating carbonyl groups on either side the result has been dehydrogenation to form an ethylene, *e.g.*, acetonyl acetone to diacetyl ethylene<sup>8</sup> and ethyl succinate to ester of fumaric acid.<sup>9</sup> The conversion of a flavanone (I) into a flavone (III) is a similar dehydrogenation<sup>10</sup> (the activating groups being a carbonyl and a phenyl group) and was usually carried out using xylene or amyl alcohol. Though this dehydrogenation may appear at first sight to be different from the other examples, it falls into line with others if an intermediate hydroxy or acetoxy stage (II) could be recognised, because the final product can then be formed by the facile elimination of a molecule of water

or acetic acid. The detection of flavonols as minor products of the reaction of flavanones may be significant on this account.

In oxidations involving the use of halogens and silver acetate, lead tetra-acetate and hydrogen peroxide the methylene group of flavanones gets hydroxylated (acetoxylation) and the C-OH bond formed thereby has the axial orientation, leading to ready elimination of water (acetic acid) forming flavones. This seems to happen in the oxidation with selenium dioxide also. Further, as in the other cases, simultaneously, a small portion of the hydroxy (acetoxy) flavanone can undergo change into the C-OH equatorial arrangement which is favourable for dehydrogenation, particularly in the presence of dilute acids added in the present work for the hydrolysis of the sugar and acetoxy groups (see Mahesh and Seshadri<sup>11</sup>). The formation of even a small quantity of flavonol could therefore be taken as a proof of hydroxylation as the initial stage of the selenium dioxide oxidation.



1. Bannerjee, N. R. and Seshadri, T. R., *J. Sci. Ind. Res.*, 1954, **13 B**, 598.
2. Pankajamani, K. S. and Seshadri, T. R., *J. Ind. Chem. Soc.*, 1954, 565.
3. Gupta, S. R. and Seshadri, T. R., *J. Chem. Soc.*, 1954, 3063.
4. Oesterle, O. A. and Wander, G., *Helv. Chim. Acta*, 1925 **8**, 519.
5. Riley, H. L., Morley, J. F. and Friend, N. A. C., *J. Chem. Soc.*, 1932, 1876.
6. Schwenk, E. and Borgwardt, E., *Ber.*, 1932, **65B**, 1601.
7. Guillemonat, A., *Ann. Chim.*, 1939, **11**, 143.
8. Armstrong, K. F. and Robinson, R., *J. Chem. Soc.*, 1934, 1650.
9. Astin, S., Moulds L. de V. and Riley, H. L., *Ibid.*, 1935, 901.
10. Mahal, H. S., Rai, H. S., and Venkataraman, K., *Ibid.*, 1935, 866.
11. Mahesh, V. B. and Seshadri, T. R., *Proc. Indian Acad. Sci.*, 1955, **41A**, 210.

MULTIPLE SPOT PHENOMENON IN INORGANIC CIRCULAR PAPER  
CHROMATOGRAPHY

A. R. VASUDEVA MURTHY AND V. A. NARAYAN

*Dept. of General Chemistry, Indian Institute of Science, Bangalore*

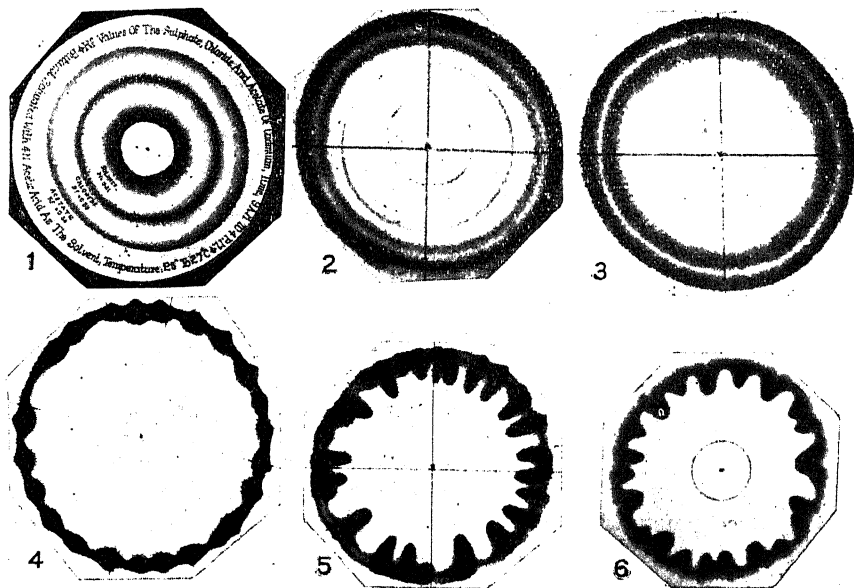
DURING our studies of circular paper chromatography of inorganic ions, certain peculiar results were noticed in some cases (about 10%) although uniform experimental conditions were maintained. A brief account of such results is given in the present communication.

The general technique of chromatography was the same as described earlier.<sup>1</sup> Whatman No. 3 filter-paper discs were used throughout. 0.05 ml. of solution which was 0.05 M. with respect to the salt was used for each experiment. The metallic bands were identified by spraying ammoniacal hydrogen sulphide. The chromatographic experiments were carried out in airtight chambers at  $27 \pm 1^\circ \text{C}$ .

It was shown<sup>2</sup> that cations like copper and cadmium can be separated into different bands corresponding to several anions associated with the metal such as sulphate, chloride, nitrate

acetic acid (1, 2, 3 N) (Fig. 2). Similarly when copper nitrate was chromatographed with the solvent, butanol saturated with 3 N acetic acid, the metallic band separated into two rings corresponding to nitrate and acetate (Fig. 3). Copper chloride also exhibited two rings, one of which was due to chloride and the other to acetate. Lead acetate irrigated with a solvent containing ethyl alcohol acetic acid and water developed two rings similar to copper salts. It was also noted that no such clear separations occurred when the irrigating solvent contained hydrochloric acid (3 N) instead of acetic acid.

In some other instances, the metallic bands exhibited a peculiar shape in the contour. Fig. 4 was obtained with copper chloride irrigated by *n*-butanol-6 N acetic acid (1:1). Fig. 5 is a chromatogram developed by copper chloride with the solvent butanol-5 N acetic

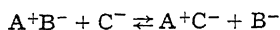


and acetate (Fig. 1) when irrigated with a solvent like butanol saturated with 4 N acetic acid. It was found subsequently that even a pure single substance such as copper acetate gave rise to two rings after irrigating the spotted disc with butanol saturated with dilute

acid (1:1). Cadmium sulphate gave rise to a star-shaped picture (Fig. 6) when chromatographed with butanol-5 N acetic acid (1:1). It is difficult to explain how these distorted pictures are obtained. Surface tension and differential wetting would play an important role

in the spreading of the solution at the initial stages but it has not been possible to identify the surface active substance which influences such a course of development.

The possibility of such a separation of metallic bands corresponding to different anions associated with the cation has been accounted for<sup>3</sup> on the basis of the equilibrium in the process of elution of a salt  $A^+B^-$  by a mobile phase containing  $C^-$  which can compete with  $B^-$  for  $A^+$



When the acid  $H^+C^-$  is present in the irrigating solvent, the formation of AC depends on its strength and on its concentration. The hydrogen-ion concentration of the solvent medium influences the mobility of the ions to a considerable extent. While this can explain partly the separation of copper chloride or nitrate into two bands corresponding to (1) chloride and acetate, (2) nitrate and acetate in the abovementioned cases it is very difficult to account for the separation of copper acetate or lead acetate into two bands with the same solvent, viz., butanol-acetic acid.

The formation of double zones in partition<sup>4</sup> chromatography has been attributed to the water-logging of the kieselguhr column when the solvent containing butanol was slightly undersaturated with water or held an excess of water in fine suspension. The composition of the solvent mixture is likely to alter as a result of such logging of water in the partition chromatography with substances like kieselguhr, silica gel or paper. Difference in temperature may also alter the composition of the solvent and introduce changes in  $R_f$  value. In the present series, multiple spots could not be obtained in every experiment conducted with butanol-acetic acid solvent containing different amounts of suspended water. Only two chromatograms out of 20 exhibited two rings corresponding to nitrate and acetate when copper nitrate was used to spot on the filter-paper. In a few trials, water was eliminated in the solvent by using only glacial acetic acid along with butanol. Even under such conditions there were a few instances where there was the formation of double rings of copper associated with nitrate and acetate. It was noticed that a wide halo surrounded the metallic band in a few

cases. In the light of the present observations it is extremely difficult to say that water content of the mobile phase greatly influences the chromatogram.

It has been observed that multiple spots are developed when the solvent used for irrigation contained a complex forming reagent with the metal under test, such as ammonia in the case of cadmium<sup>5</sup> or aceto-acetic ester in the case of cobalt<sup>6</sup> or benzyl acetone with copper.<sup>3</sup> Such a separation of a single metal into different zones is attributed to the formation of different complexes which move with different  $R_f$  values. It should be noted that the present authors have obtained such clearly separated metallic bands even in the case of single common ion between the test solution and the solvent without the presence of any complexing reagent. "Ghosts" and "shadow" spots found along with the metallic spots were attributed to the alkaline earth and heavy metal impurities<sup>7</sup> in paper in the case of the separation of phosphoric esters. In the present case, however, the analysis was mainly with metals such as Cu, Cd or Pb which remain unaffected even in the presence of such impurities in the paper.

It may be concluded from the present work that multiple spots can be obtained with a metal moving as two or more species. For quantitative analysis particularly, it is essential that a metal should move as a single band and give sharply defined boundary. It therefore becomes necessary to run a large number of experiments in order to be certain of the species obtained by chromatographic analysis.

The authors wish to express their grateful thanks to Dr. M. R. A. Rao and Prof. K. R. Krishnaswami for their keen interest in the work.

1. Vasudeva Murthy, A. R., Narayan, V. A. and Rao, M. R. A., *Curr. Sci.*, 1955, **24**, 158.
2. — and —, *Naturwissenschaften*, 1955, **42**, 439.
3. Pollard, F. H., McOmie, J. F. W., Martin, J. V. and Hardy, C. J., *J. Chem. Soc.*, 1955, 4332.
4. Lester Smith, F., *Nature*, 1952, **169**, 60.
5. Hahn, H. V., Sorkin, E. and Erlenmeyer, H., *Experientia*, 1951, **7**, 258.
6. Erdem, B., and Erlenmeyer, H. *Helv. Chim. Acta*, 1954, **37**, 2220.
7. Hanes, C. S. and Isherwood, F. A., *Nature*, 1949, **164**, 1107.

## THE TRAINING OF UNIVERSITY TEACHERS

WHILE the presentation of a subject in the lecture room may be impeccable as regards content, quite often it leaves much to be desired in the matter of teaching technique. Ways and means for improving this aspect of the matter are suggested by S. Radcliffe in the *Bristol University Review* (Vol. 28, No. 1, Oct. 1955).

According to Radcliffe the following are a few of the purely mechanical skills which might be considered desirable in a good teacher or lecturer. First, the adoption of a fitting speed and clarity of diction. Secondly, the clear formulation and appropriate stressing of the main points of the subject under review. Thirdly, the ability to use a blackboard successfully. Fourthly, the 'staging' of material to make it come 'alive'. The correct lighting and ventilation of the lecture room are of importance. A few weeks teaching in any school will bring these and many allied points home.

What is a fitting speed and clarity of diction? How many lecturers ask their students whether they can hear clearly, or whether they are speaking too quickly for them? A teacher can soon learn the correct measure in these instances with the aid of a little guidance. The undue dropping of the voice at the end of each sentence, for example, can produce both monotony and inaudibility. A person with a weak voice can be shown how to make the most of it by someone trained in these matters. This is a problem faced by teacher-training departments.

The clear formulation and appropriate stressing of the main points of the subject cover a large number of factors. Just as the potential teacher must learn how to arrange and present the various points he is intending to convey in a lesson, so must the lecturer have a

clear and systematically arranged plan of what he intends to talk about. He must know which points are important or difficult enough to require particular stressing, either in the form of repetition or slower and more deliberate speaking, or even by the dictation of vitally relevant matter.

The extent to which the blackboard is used will obviously vary with the nature of the lecture; a statistical, technical or linguistic theme will call for more blackboard writing than, say, a literature or philosophy lecture. Titles of works, proper names, unusual or foreign terms, dates—all these should be written up to ensure that students get the correct form. The writing must be clear and legible, and not scattered about in disorder on the board.

Lastly, Radcliffe elucidates his reference to the proper 'staging' of material. There is an element of the histrionic in all personal teaching; the teacher is to some extent an actor, who must make his material come to life. There are some generally recognized devices into the application of which the tyro could with advantage be initiated. A slight break before passing on to a new theme in a lecture can be most refreshing for all concerned. An occasional pause to receive questions from students will in certain cases add to the effectiveness of the lecture; it "draws the students in" more and gives the lecturer a chance to gauge their grasp of what he is saying. Learning the students' names is an essential requirement in establishing such closer contact with them. The prompt return of written work not only helps to keep up students' interest in their subject, but also gives the right to demand written work from the students within the time-limit specified.

## PREPARATION OF ILLUSTRATIONS FOR PUBLICATION

ILLUSTRATIONS in the form of drawings or graphs are often the most important feature of a scientific paper, and many research workers with little or no previous experience in the matter sometimes unwittingly cause considerable extra trouble and expense in editorial offices by submitting illustrations which require a great deal of alteration before they are suitable for reproduction. Most journals have their own peculiarities, and before submission of a paper intending authors should examine the particular journal they have in mind to see, for example, if any particular form and

size of lettering is favoured. In this connection intending authors could not do better than consult "Notes on Preparation of Illustrations", prepared by the Editorial Office of the *Biochemical Journal* (price 1 sh., from the Lister Institute of Preventive Medicine, Chelsea Bridge Road, London, S.W.1). This gives simple instructions, and deals with the essentials of the matter in a particularly direct way. Its acquisition by departments and/or individuals for the modest outlay of about a rupee is a worth-while investment.



## LETTERS TO THE EDITOR

	PAGE		PAGE
<i>Production Functions for Large-Scale Indian Establishments</i> —ANANT PANDEY	148	<i>Two Fungal Infections of Hevea Seeds</i> —S. N. S. SRIVASTAVA	157
<i>Near Ultraviolet Absorption Spectra of Certain Substituted Heterocyclic Compounds</i> —V. SANTHAMMA	149	<i>Benthic Organisms of a Fresh-Water Fish-Tank</i> —VINAY K. SRIVASTAVA	158
<i>Emission Bands of Benzonitrile</i> —R. K. ASUNDI AND B. D. JOSHI	150	<i>Use of Organo-Mercurial Fungicide as Sett Treatment for Sugarcane</i> —M. S. SUBBA RAO, N. S. NEGI AND K. L. KHANNA	159
<i>New Emission Spectrum of Iodine in the Far and Vacuum Ultraviolet</i> —P. B. V. HARANATH AND P. TIRUVENGANNA RAO	151	<i>Pseudonapomyza atra on Maize Leaves</i> —D. BAP REDDY	160
<i>Variation of the Number of Isotopes and Isobars in Alpha and Beta Decay</i> —H. K. RAUT	152	<i>On Methyl Bromide as a Plant Fumigant</i> —J. T. RAO AND A. S. ETHIRAJAN	160
<i>The Raman Spectrum of p-Tolyl Isothiocyanate</i> —P. G. PURANIK AND A. M. JAYA RAO	153	<i>Cytology of the Ophioglossaceae</i> —C. A. NINAN	161
<i>Sedimentary Environments Off Kalingapatam-Gopalpur Coast by Coarse-Fraction Studies</i> —M. SUBBA RAO	154	<i>Development of Endosperm and Nucellar Polyembryony in Aegle marmelos Correa</i> —B. M. JOHRI AND M. R. AHUJA	162
<i>Some Cytoplasmic Details of Yeast Revealed by the Electron Microscope</i> —(MISS) SARASWATHY ROYAN AND D. L. BHATTACHARYA	155	<i>Scilla indica in India</i> —Y. SUNDAR RAO	164
<i>Digestive Enzymes of Martesia striata Linn.</i> —P. N. GANAPATI AND R. NAGABHUSHANAM	156	<i>Cytology of Gloriosa</i> —T. N. KHOSHOO	165
		<i>The Syntheses of Huttonite and Monazite</i> —M. D. KARKHANAVALA	166
		<i>Observations of Direct Solar and Diffuse Sky Radiation during Solar Eclipse</i> —R. RAMANADHAM AND V. P. SUBRAMANYAM	167
		<i>Cytology of Indian Gleicheniaceae</i> —P. N. MEHRA AND GURDIP SINGH	168

### PRODUCTION FUNCTIONS FOR LARGE-SCALE INDIAN ESTABLISHMENTS

ECONOMETRIC models for net output in terms of the main factors of production, viz., labour and capital, have been derived by the author. The present note is a brief report on the detailed paper to be published in *Sankhya*. The Douglas-type production function, i.e., a function which is linear in the logarithms, has been fitted by the least square method for large-scale Indian establishments for the years 1948 to 1952. Cross-section data, as published in the *Reports of the Census of Indian Manufactures* for the major industries, have been used.

In non-logarithmic form the above type of production function would appear as

$$P = a_0 L^{a_1} C^{a_2} \quad (1)$$

where P is the value added by manufacture, L represents the contribution of labour and C that of fixed and working capital employed in the manufacture.

In the present study P and C are in lakhs of rupees, and L is the number of lakhs of man-hours put in, obtained from the following expression for the total man-hours:

$$2400n_s + m + \frac{2}{3}w + \frac{1}{2}C \quad (2)$$

where  $n_s$  is the number of salaried workers (supposed to be working 8 hours a day for 300 days in the year),  $m$ ,  $w$ ,  $c$  are the hours of work put in during the year by men, women and children respectively, and  $2/3$  and  $1/2$  are ratios between the work of an average woman and child wage-earner respectively to that of an average man wage-earner.

The values of the constants  $a_0$ ,  $a_1$ ,  $a_2$  in equation (1), the last two being respectively the

elasticities of production with respect to labour and capital, are set out in the following table :

Year	$a_0$	$a_1$	$a_2$	$a_1 + a_2$
1948	.602	.625	.376	1.001
1949	.747	.566	.400	0.966
1950	.792	.421	.533	0.954
1951	.677	.549	.431	0.980
1952	.202	.832	.281	1.113

In none of the five cases under consideration is the sum of the exponents  $a_1$  and  $a_2$  significantly different from 1, indicating the existence of constant returns to scale in Indian manufactures.

I am thankful to Dr. T. P. Chaudhuri and Dr. Des Raj for useful suggestions in this study.

Indian Statistical Inst., ANANT PANDEY.\*  
Calcutta-35, February 18, 1956.

1. *Report of the Census of Indian Manufactures*, 1948, 49, 50, 51 and 52.

2. Douglas, P. H., *Theory of Wages*, New York, 1928.

3. — and Gunn, G., *Quart. J. Economics*, 1941, 56, pp. 108 ff.

\* Present Address: Faculty of Commerce, The University, Lucknow.

### NEAR ULTRAVIOLET ABSORPTION SPECTRA OF CERTAIN SUBSTITUTED HETEROCYCLIC COMPOUNDS

THE absorption spectra of a number of substituted heterocyclic compounds in the vapour state have been photographed in the region  $\lambda$  3,000–2,250, using Hilger's Littrow, medium and small quartz spectrographs. The spectra have been studied by varying the length of the vapour column from 2 cm. to 100 cm., the temperature of the liquid container being varied from  $-15^\circ\text{C}$ . to  $90^\circ\text{C}$ . For two of the compounds (2, 5-dimethyl furan and pyrrolidine) fairly intense and discrete absorption bands which are not previously recorded, have been observed. For 2-furfuraldehyde, a very rich and intense band system consisting of many more bands than were recorded by Purvis<sup>1</sup> has been obtained. In all these cases, the bands appear in groups, the components of which show some regularity. A qualitative study of the polarisation characteristics of the Raman lines of 2, 5 dimethyl furan and 2-furfuraldehyde has also been carried out while for pyrrolidine, the data regarding the depolarisation factors as determined by Kohlrausch<sup>2</sup> and Reitz, have been used. The location of the 0, 0 band is made from a study of the develop-

ment of the spectrum at different temperatures and its appearance at the minimum vapour pressure conditions. The intensity of absorption and the analysis of the bands in each case indicated that the electronic transition giving rise to the spectrum is of an allowed type. The results are presented in Tables I and II. The ground state frequencies agree well with the Raman<sup>3</sup> lines in all the three cases and also with those obtained from the study of the infra-red absorption<sup>4</sup> in pyrrolidine.

TABLE I

Molecule and symmetry	Region of absorption in Å	$\nu_{0,0}$ band in $\text{cm}^{-1}$
2-Furfuraldehyde $C_s$	2800–2450	37107
2, 5-dimethyl furan $C_{2v}$	2510–2250	40541
Pyrrolidine $C_s$	2720–2454	38349

TABLE II  
Frequencies in  $\text{cm}^{-1}$

2-Furfuraldehyde		2, 5-Dimethyl furan		Pyrrolidine	
Ground State	Excited State	Ground State	Excited State	Ground State	Excited State
204	..	265	..	230	175
290	202	..	..	..	..
..	380	606	442	597	429
616	446	..	492	865	675
742	561	..	645	..	889
878	742	..	..	..	..
..	883	..	954	1102	..
1149	1028	..	1244	1226	1063
1359	1284	..	..	..	..
..	1385	..	1532	..	1314
..	1478	..	..	..	..
..	2393	..	..	..	..
..	2927	..	..	..	..

The details of the interpretation of the bands and the assignment of the frequencies will be published elsewhere.

Dept. of Physics, V. SANTHAMMA.  
Andhra University,  
Waltair, January 16, 1956.

1. Purvis, J. E., *J. Chem. Soc.*, 1910, 67, 1649.

2. Kohlrausch, K. W. F. and Reitz, A. W., *Z. Physik. Chem. Abt.*, 1940, 45B, 249.

3. Magat, M., *Numerical Data on Raman Effect*, 1934.

4. Tschamler, H. and Voetter, H., *Monatsch*, 1952, 83, 302.

## EMISSION BANDS OF BENZONITRILE

IN the course of our attempts to excite the emission spectra of polyatomic molecules it has been possible to obtain several emission bands in a h.f. discharge through flowing as well as stagnant vapour of benzonitrile. These bands lie between 2,680 and 2,925 Å and have been photographed on a large quartz Hilger Littrow Spectrograph which has a dispersion of about 4 Å/mm. in this region. The bands are all sharp and degraded towards longer waves. Forty of such bands have been measured with an accuracy of  $\pm 3$  wavenumbers. Fourteen of these agree in wavelengths with the absorption bands<sup>1</sup> of benzonitrile and all except a couple of them also agree fairly well with the data given by Bass<sup>2</sup> of the fluorescence bands of benzonitrile. The bands are therefore in all probability due to benzonitrile.

The spectrum consists of discrete bands superposed on a continuum. Fig. 1 is a reproduction of a typical spectrogram of the bands and on it is shown also the general analysis of the more prominent bands. The bands allow themselves to be regarded as due to an allowed transition, probably  $B_1 \rightarrow A_1$ , assuming  $C_{2v}$  symmetry. The strong band at 36,520  $\text{cm}^{-1}$  is the zero band of the system, as is already known in fluorescence at 36,519  $\text{cm}^{-1}$  and in absorption at 36,516  $\text{cm}^{-1}$ . A comparison with the fluorescence bands is given below.

cence spectrum contains about 145 bands and has been interpreted in terms of twenty ground state frequencies whereas here only 40 bands are observed, involving eight ground state and three upper state frequencies. In the fluorescence spectrum no bands have been measured on the shorter wavelength side of the zero band, while here five weak bands appear in that region, which, except for one band, appear in absorption also.

In the emission spectrum there occur bands at 35,933, 34,889, 34,472, 34,432, 34,383 and 34,282  $\text{cm}^{-1}$  which are not reported in fluorescence. The bands at 35,603 and 35,395  $\text{cm}^{-1}$  which were left unassigned earlier, receive satisfactory assignments in the present studies. In the studies in fluorescence a large number of bands have two or more possible assignments. The emission spectrum has been helpful in choosing the more probable ones out of these.

There is good agreement in the values for the ground state frequencies obtained in the two methods except in two cases. The frequency 629 as measured here is in agreement with that obtained from Raman effect<sup>1,3</sup> (624) and from ultraviolet absorption bands<sup>1</sup> (626), but differs from what appears to be the same vibration of frequency 618 in fluorescence which however agrees better with the results obtained from infrared absorption<sup>4</sup> and ultraviolet

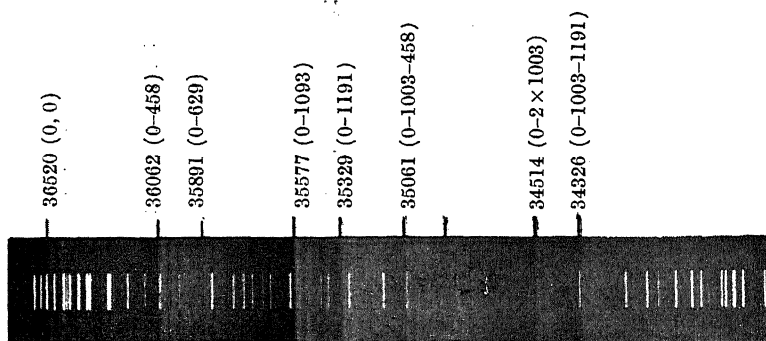


FIG. 1. Emission bands of benzonitrile in flowing vapour, photographed on large quartz Hilger Littrow Spectrograph. Slit-width 0.035 mm. Exposure time seven hours.

The relative intensities of the bands are, more or less, the same in both spectra except for one marked difference. In the fluorescence spectrum the zero band and its long wavelength companions are weak while here they appear with a much higher intensity. The fluores-

absorption studies by Masaki<sup>5</sup> (616). Similarly the ground state frequency 670 as obtained here agrees well with that reported in ultraviolet absorption<sup>1</sup> (670) as compared with the value 681 reported in fluorescence. In fluorescence the prominent bands are accompanied by long

wavelength companions at separations of 15 and 40 cm.<sup>-1</sup>, while here only the companions at separations of 41 cm.<sup>-1</sup> are seen to occur.

Details will be published elsewhere.

Dept. of Spectroscopy,  
Banaras Hindu University,  
February 20, 1956.

R. K. ASUNDI.  
B. D. JOSHI.

1. Hirt, R. K. and Howe, J. P., *J. Chem. Phys.*, 1948, **16**, 480.
2. Bass, A. M., *Ibid.*, 1950, **18**, 1403.
3. Kohlrausch, K. M. P. and Pongrantz, A., *Monats. f. Chem.*, 1933, **63**, 427.
4. Barchewitz, R. and Parodi, M., *Comptes Rendus*, 1939, **209**, 30.
5. Masaki, K., *Bull. Chem. Soc.*, Japan, 1936, **11**, 346.

### NEW EMISSION SPECTRUM OF IODINE IN THE FAR AND VACUUM ULTRAVIOLET

THE electrical excitation of iodine vapour has been studied by the authors using two different sources—a condensed transformer discharge and a high frequency discharge from a high power oscillator (100 watts). Photographs of the spectra reveal a new emission spectrum of neutral iodine molecule, particularly in the region  $\lambda$  2,500 to  $\lambda$  1,300.

Pure iodine vapour was excited in an ordinary H-shaped discharge tube of internal diameter 20 mm. by passing a condensed discharge from a 20 KV transformer. Surrounding the intense green discharge due to the atomic line spectrum of iodine, a characteristic bluish violet emission was observed. This characteristic glow was photographed in the region from  $\lambda$  6,500 to  $\lambda$  1,950 using Glass Littrow instrument in the visible region and Hilger small and medium quartz spectrographs in the far and near ultraviolet regions. Below  $\lambda$  1,950 down to  $\lambda$  1,000, one meter normal incidence vacuum grating spectrograph having a dispersion of 17.3 Å/mm. was employed. Eight discrete band systems in the region  $\lambda$  6,500 to  $\lambda$  1,950 as shown in Table I together with a number of semi-continuous bands at  $\lambda$  4,745; 4,660; 4,575; 3,520; 3,480; 2,880; 2,865; 2,855; 2,845; 2,835; and 2,825 were observed. The visible band system  $\lambda$  6,500– $\lambda$  5,000 is earlier known to occur in high frequency excitation of pure iodine vapour, and the four discrete band systems in the region  $\lambda$  4,400 to  $\lambda$  2,520 are known to occur in the fluorescence and electrical excitations of iodine vapour in the presence of nitrogen or argon.<sup>1-3</sup> Some of the semi-continuous bands are identified with those observed

by Venkateswarulu,<sup>3</sup> using an uncondensed transformer discharge in the presence of argon. Below  $\lambda$  2,500, our photographs reveal three new discrete band systems in the region up to  $\lambda$  1,950 and thirteen systems in the region  $\lambda$  1,950 to  $\lambda$  1,460 as shown in Table I. These discrete band systems in the region  $\lambda$  2,500 to  $\lambda$  1,460 have been obtained for the first time in emission. Some of the bands belonging to the systems in the region  $\lambda$  2,500 to  $\lambda$  1,950 coincide with those reported by Pringshiem and Rosen<sup>4</sup> and Kimura and Miyanshi<sup>5</sup> in absorption. Below  $\lambda$  1,950, some of the band systems in Table I have been reported earlier by Cordes<sup>6</sup> in absorption.

The spectrum of iodine vapour excited by a high power high frequency oscillator was found to be quite similar to the one obtained in the condensed transformer discharge in the region  $\lambda$  2,230 to  $\lambda$  1,300. All the band systems mentioned previously in this region are clearly obtained. The prominent system extending between  $\lambda$  1,950 to  $\lambda$  1,790 is found to consist of about 200 band heads as against only 90 bands reported by Cordes in absorption. The spectrum in the region  $\lambda$  6,500 to  $\lambda$  2,400 consists of only one discrete band system in the visible region, and a number of diffuse bands in the region  $\lambda$  4,800 to  $\lambda$  2,400 which were reported and interpreted by Venkateswarulu.

Recently, Venkateswarulu<sup>3</sup> has reported the analyses of the four band systems in the region  $\lambda$  4,400 to  $\lambda$  2,520 and interpreted them in terms of the well-established term scheme of the neutral iodine molecule. Our present emission pictures revealed the existence of three new band systems in the region  $\lambda$  2,500 to  $\lambda$  1,950. For two of these which are well developed, the vibrational constants are given in Table I. In addition to the extensive system lying between  $\lambda$  1,950– $\lambda$  1,790, analysed and interpreted by Venkateswarulu, Cordes has identified seven brief band systems in the region  $\lambda$  1,790 to  $\lambda$  1,540. He explained six of these systems as due to the transitions from the ground state to various upper states. The positions of these levels, however, are uncertain as there is considerable overlapping of these systems in this region. For identifying the number of systems and the positions of the levels involved, a close study of the emission spectrum in this region is more desirable. Our emission pictures reveal clearly the existence of twelve brief systems in the region  $\lambda$  1,790 to  $\lambda$  1,460. For all of these except two, the positions of the upper levels ( $\sim v_0, 0$ ) and the approximate vibrational frequencies are given in Table I.

TABLE I

Discrete band systems due to stable electronic levels in the neutral iodine molecule

No.	Extent of the region of the spectrum in Å	Vibrational frequencies		System origin $\nu_e$ cm. <sup>-1</sup>
		$\omega_e'$	$\omega_e''$	
1	9300-8375	44.0	213.8	11803
2	6700-5000	126.6	213.8	15598
3	4420-4000	101.9	126.6	25757
4	3455-3015	103.0	213.8	39131
5	2785-2750	104.5	213.8	45781
6	2730-2520	96.2	213.8	47150
7*	2500-2400	..	..	..
8*	2415-2240	93.4	213.8	45230
9*	2230-1950	79.0	213.8	48072
10	1950-1790	165	213.8	51683
11*	1785-1740	223	213.8	56754
12	1780-1725	210	213.8	56930
13	1750-1700	236	213.8	57794
14*	1715-1680	240	213.8	58875
15	1710-1670	206	213.8	59254
16*	1670-1645	103	213.8	60686
17*	1640-1620	110	213.8	61335
18*	1615-1585	170	213.8	62586
19*	1595-1560	240	213.8	63458
20	1570-1540	130	213.8	64317
21*	1545-1500	170	213.8	65776
22*	1490-1460	134	213.8	67699

The systems marked with (\*) are newly identified and analysed in the present work.

System 7 is not well developed. System 10 was recorded by Cordes in absorption and analysed by Venkateswarulu. Systems 12, 13, 15, 18 and 21 were obtained and analysed by Cordes in absorption. Some more additional bands belonging to these systems were obtained by us in emission.

Full details of analyses of all the systems newly obtained and analysed in the present work, and a complete discussion on the nature of the electronic states of the neutral iodine molecule in terms of electron configurations will be published shortly.

P. B. V. HARANATH.

P. TIRUVENGANNA RAO.

Dept. of Physics,  
Andhra University,  
Waltair, February 6, 1956.

## VARIATION OF THE NUMBER OF ISOTOPES AND ISOBARS IN ALPHA AND BETA DECAY

At present there are several alpha decay chains of artificially produced radioactive nuclides.<sup>1-3</sup> Most of these isotopes and isobars for alpha decay are from Pt ( $Z=78$ ) to Cm ( $Z=96$ ) as given by Pryce.<sup>4</sup> Cases of isotopes and isobars from elements of atomic number 80 to 96 that take part in alpha decay have been considered. Cases of beta decay within the same range have also been considered for the sake of comparison. The data on such isotopes and isobars was taken from Feingold.<sup>5</sup>

Graphs have been plotted between atomic number ( $Z$ ) and the number of isotopes (Fig. 1), and between mass number ( $A$ ) and

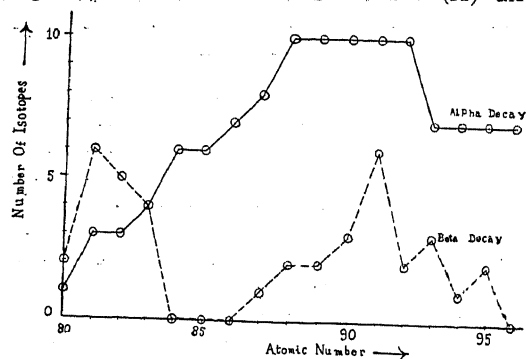


FIG. 1

the number of isobars (Fig. 2) for alpha and beta decay.

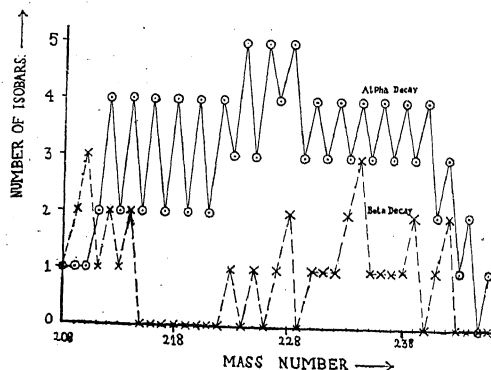


FIG. 2

(a) Isotopes.—For alpha decay, the number of isotopes is minimum for  $Z=80$ . It goes on increasing for higher atomic numbers until a constant value is attained from 88 to 92. After 92 it again falls down but remains constant after 93. For beta decay, the graph shows periodic fluctuations of maxima and minima. Maxima of six is attained at  $Z=81$  and 91.

1. Elliot, A., *Proc. Roy. Soc., London*, 1940, **1A**, 74, 273.
2. Waser, J. and Wieland, K., *Nature*, 1947, **160**, 643.
3. Venkateswarulu, Putcha, *Phys. Rev.*, 1951, **81**, 821.
4. Pringshiem and Rosen, *Zeits. f. Phys.*, 1928, **50**, 1.
5. Kimura and Miyanshi, *Sci. Papers, Inst. Phys. Chem. Res.*, Tokyo, 1929, **10**, 33.
6. Cordes, H., *Zeits. f. Phys.*, 1935, **97**, 603.

A flat minimum occurs for 84, 85 and 86. Another minimum is at 96.

The alpha and beta curves roughly vary in the same manner. The number of isotopes for alpha decay is more than the corresponding number for beta decay for any atomic number from 84 onwards. Also for beta decay maxima and minima are observed at almost regular intervals.

(b) *Isobars*.—In the case of alpha decay, the number of isobars is smallest at  $A = 210$ . Then it rises and goes through maximum and minimum values till the end. The maximum value is attained at  $A = 224, 226$  and  $228$ . This also shows that the number of isobars is generally always high for even mass numbers and low for odd ones, which is very interesting.

For beta decay, the maxima and minima are also observed at somewhat regular intervals. The first maximum occurs at 210 and second maximum at 234. Also the number of isobars for a particular mass number is always more in the case of alpha decay than the corresponding case of beta decay.

The increase of the number of isotopes and isobars in alpha and beta decay for heavier elements is due to their reduced stability. The periodic table ends after  $Z = 96$ , because of the increasingly negative values of the binding energies for alpha emission and fission.

But the periodic fluctuations of the number of isotopes and isobars in beta decay and the increase of number of isobars for even mass numbers and decrease of the same for odd ones in the case of alpha decay cannot be explained on the basis of recent theories. This also shows that the elements of even mass numbers are less stable than those of odd ones in the case of alpha decay. These facts have passed unnoticed, so far. The various theories regarding alpha and beta decay have to be suitably modified to account for these important observations, which may throw more light on nuclear structure.

Dept. of Physics,  
Ravenshaw College,  
Cuttack, February 21, 1956.

H. K. RAUT.

## THE RAMAN SPECTRUM OF *p*-TOLYL ISOTHIOCYANATE

THE Raman spectrum of *p*-tolyl isothiocyanate has been recorded earlier by Dadiou.<sup>1</sup> Using a Hilger Raman Source Unit and a Fuess glass spectrograph having a dispersion of  $19 \text{ cm}^{-1}$  per mm. in the  $\lambda 4,358$  region, the authors have recorded in 25 minutes, an intense Raman spectrum of this cyanate, which shows eight new frequencies and a band at  $2,015 \text{ cm}^{-1}$  of about  $110 \text{ cm}^{-1}$  width. The results are given below with the usual conventions.

338(3), 397(0), 500(1), 595(0), 650(7), 693( $\frac{1}{2}$ ), 742( $\frac{1}{2}$ ), 786(5), 874( $\frac{1}{2}$ ), 925( $\frac{1}{2}$ ), 1,016(1), 1,066(0), 1,114(1), 1,141(1), 1,170(9); 1,205(1), 1,241(10), 1,276(1), 1,298(1), 1,370(2); 1,430( $\frac{1}{2}$ ), 1,498(7), 1,575(1), 1,604(10), 2,015-2,128(3 b), 2,174(2), 2,923(3), 3,070(2).

Three lines at 1,298, 1,575 and  $1,430 \text{ cm}^{-1}$  appear respectively to be the overtones and the summation tone of the fundamentals of the C=S vibrations at  $650 \text{ cm}^{-1}$  and  $786 \text{ cm}^{-1}$ . Regarding the intense line at  $1,241 \text{ cm}^{-1}$ , the authors propose to ascribe it to the C-N bond formed by the carbon of the ring and the nitrogen of the thiocyanate. On the basis of the infra-red data for aromatic amines, Colthup<sup>2</sup> has assigned the strong absorption bands in the region of  $1,250\text{--}1,340 \text{ cm}^{-1}$  to the C-N bond. A comparison between the frequencies of the  $>\text{C-O}$  in aromatic esters at  $1,270 \text{ cm}^{-1}$  as proposed by one of the authors<sup>3</sup> and the frequency of  $>\text{C-N}=\text{bond}$  at  $1,241 \text{ cm}^{-1}$  in the present case, indicates a confirmation of the proposed assignment of  $1,241 \text{ cm}^{-1}$  to the  $>\text{C-N}$  vibrations in the isothiocyanate. Further a comparison of the frequencies of *p*-tolyl isothiocyanate ( $\text{H}_3\text{C} \text{---} \text{C}_6\text{H}_4 \text{---} \text{N}=\text{C}=\text{S}$ ) with those of the simpler molecules such as toluene ( $\text{H}_3\text{C} \text{---} \text{C}_6\text{H}_5$ ), phenyl hydrazine ( $\text{C}_6\text{H}_5 \text{---} \text{NH.NH}_2$ ) and aniline ( $\text{C}_6\text{H}_5 \text{---} \text{NH}_2$ ), reveals significantly that with the removal of the  $-\text{N}=\text{group}$  from the molecule, such as in toluene, the line of comparable intensity in the region  $1,250 \text{ cm}^{-1}$  disappears.

Another interesting point arises out of two lines at 1,114 and  $1,141 \text{ cm}^{-1}$  missed by Dadiou. Both these lines cannot be explained as being the overtones or the combination tones of the fundamentals. The lines 338 and  $786 \text{ cm}^{-1}$  can, however, give rise to a summation tone at  $1,124 \text{ cm}^{-1}$ , which happens to be the mean of 1,114 and  $1,141 \text{ cm}^{-1}$ . Probably this is a case of Fermi Resonance, which results in the line

1. Perlman, I., Ghiorso, A. and Seaborg, G. T., *Phys. Rev.*, 1950, **77**, 29.
2. Meinke, W. W., Ghiorso, A. and Seaborg, G. T., *Ibid.*, 1948, **75**, 314.
3. Studier, M. H. and Hyde, E. K., *Ibid.*, 1947, **75**, 314.
4. Pryce, M. H. L., *Proc. Phys. Soc.*, London, 1950, **63**, 692.
5. Feingold Arnold, M., *Rev. Mod. Phys.*, 1951, **23**, 11.

at  $1,124\text{ cm}^{-1}$  splitting into two lines of equal intensities.

The authors thank Professor S. Bhagavan-tam for his guidance and acknowledge with thanks the pure sample of the compound made available to them by Dr. V. R. Srinivasan of the Department of Chemistry, Osmania University.

Physical Labs. and  
Physics Dept.,  
Osmania University,  
Hyderabad-7, March 13, 1956.

P. G. PURANIK.  
A. M. JAYA RAO.

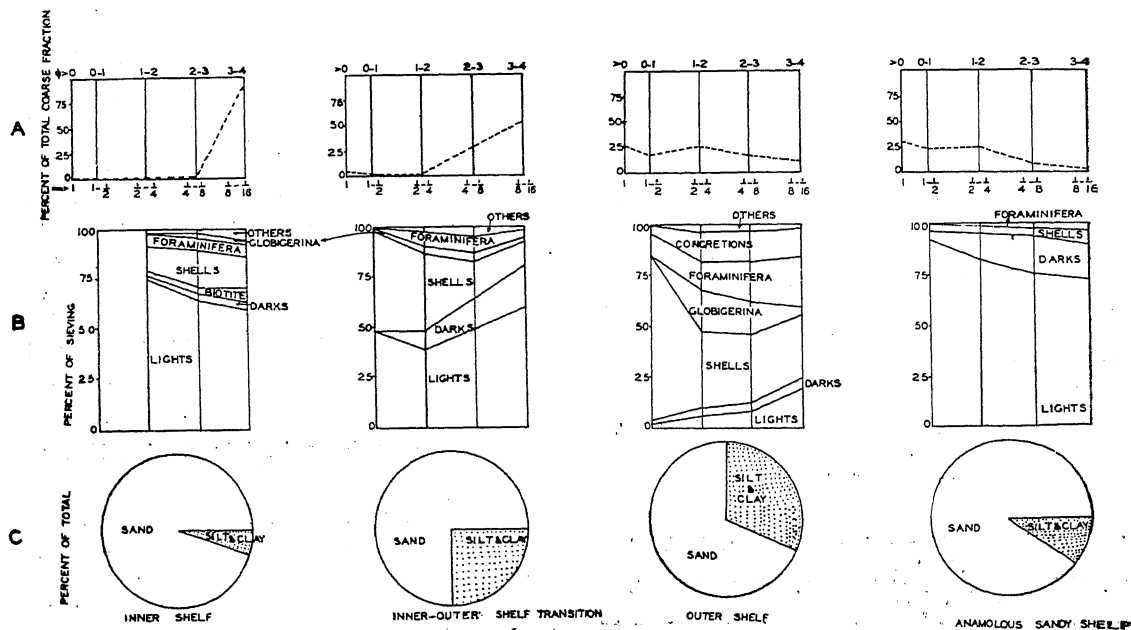
1. Dadiou, A., *Wien Ber.*, 1930, **139**, 620.
2. Colthup, *Jour. Opt. Soc. Ame.*, 1950, **40**, 397.
3. Puranik, P. G., *Proc. Ind. Acad. Sci.*, 1955, **42**, 326.

### SEDIMENTARY ENVIRONMENTS OFF KALINGAPATAM-GOPALPUR COAST BY COARSE-FRACTION STUDIES

RESULTS of preliminary studies on marine sediments off Kalingapatam on the east coast of India were reported by Mahadevan and Subbarao.<sup>1</sup> During these studies it has been found that the size analysis of some of the samples are not reliably correlative among themselves as they contain mostly shells and concretions which have grown in or near their place of

a method adapted by Shepard and Moore<sup>2,3</sup> in the study of Central Texas marine sediments and by Wimberley<sup>4</sup> for investigating the sediments north of La Jolla Submarine canyon, California.

In the coarse-fraction method, about 50 g. of oven-dried sample are soaked overnight in a dispersing solution of sodium hexa-meta phosphate and is then wet-sieved through a 0.066 mm. (Endecott Mesh No. 240) screen to separate the sand size fraction from silt and clay. The coarse-fraction is dried and sieved in a Rotap to the (approximate) Wentworth size grades. A representative split from each of the sieving is studied under the binocular microscope and percentages by volume of significant constituents such as shells, terrigenous minerals, etc., are estimated. The results are averaged for groups of samples that appear to reflect the same environmental influences and compiled into diagrams. Fig. A represents the histogram of mechanical analysis; Fig. B represents the percentage by volume of the constituents in each of the sieve fractions but makes no reference to the weight of each size fraction. Fig. C, known as 'pie diagram', illustrates the sand and silt and clay percentages in the entire sample. A set of these three diagrams



FIGS. A-C

deposition and as such are not strongly influenced by transporting agents such as currents and waves. These sediments are, therefore, further subjected to 'coarse-fraction analysis',

will depict a complete environmental picture of the sediment.

Light-coloured minerals (Lights) such as quartz and felspar, dark minerals (Darks) in-

cluding black opaques, garnet, biotite, etc., shells, benthonic foraminifera, pelagic foraminifera and concretions were the constituents considered significant and diagnostic in the area for the purposes of estimations. Others such as plant fibres, rock fragments, etc., were also considered.

The inner-shelf environment, extending from depths of about 5 fathoms out to 20 fathoms, is characterised by (i) absence of coarse sand, (ii) abundance of biotite among the dark minerals, especially opposite Vamsadhara confluence, (iii) large percentages of terrigenous minerals, and (iv) minor amounts of shells and foraminifera. The sediments from this environment are highly well-sorted in the 1/8-1/16 mm. size grade.

Sediments of the outer-shelf environment extending from depths of 40 fathoms down to 100 fathoms are characterised by preponderance of shells, foraminifera and concretions. Terrigenous minerals increase in quantity in the finer size grades. Pelagic foraminifera (globigerina type) and concretions essentially of calcium carbonate<sup>5</sup> in appreciable amounts are most characteristic of this environment. In contrast to the inner-shelf sediments these show very poor sorting of their constituents.

Towards the north of the area under investigation the outermost shelf beyond the depth of 60 fathoms consists only of plastic grey-coloured muds (not illustrated).

The part of the shelf lying between the depths of 20-40 fathoms (the inner-outer shelf transition zone), constitutes a distinct depositional environment. The sediments from this environment differ from those of the inner shelf in having larger percentage of shells and significant amounts of coarse sand. Further, unlike the outer-shelf sediments these contain terrigenous minerals predominating over others. Unusual occurrence of sand somewhat coarser in association with clays and silts in these depths all along the eastern coast was reported by Poornachandra Rao.<sup>5</sup>

In such a general dispositional pattern of the environments occur two very coarse sandy patches possessing characteristics altogether different from those of the above. These sands contain small quantities of silt and clay. Shells, though present, are not significant. They contain, on the other hand, large amounts of dark minerals.

In general, in Kalingapatam area, there is a seaward progression of the constituents of the coarse-fraction, shells increasing outward while sand content decreasing. The environ-

ments as revealed by these studies fit into the zonal delineation made on the basis of calcium carbonate content and grain size distribution of the sediments.<sup>1</sup>

Full details will be published elsewhere.

The studies were sponsored by the Council of Scientific and Industrial Research.

The author takes this opportunity to express his thanks to Professor C. Mahadevan and Dr. M. Poornachandra Rao, for their keen interest in the work.

Dept. of Geology,  
Andhra University,

M. SUBBA RAO.

Waltair, April 2, 1956.

1. Mahadevan, C. and Subba Rao, M., *Curr. Sci.*, 1955, **24**, 412.
2. Shepard, F. P. and Moor, D. G., *Bull. Amer. Assn. Petr. Geol.*, 1954, **38**, (8), 1792-94.
3. —, *Ibid.*, 1955, **39** (8), 1500.
4. Stanley, C. Winklerley, *J. Sed. Petr.*, 1955, **25** (1), 28.
5. Poornachandra Rao, M., *Doctoral Thesis, Andhra University*, 1955 (unpublished).

#### SOME CYTOPLASMIC DETAILS OF YEAST REVEALED BY THE ELECTRON MICROSCOPE

It was reported recently<sup>1,2</sup> that even in ultra-thin sections of yeast fixed in osmium tetroxide structural details could not be made out owing to the cytoplasm being impenetrable to the electron beam. Bartholomew and Mittler<sup>3</sup> used ultra-violet photolytic methods to obtain electron micrographs of the internal structure.

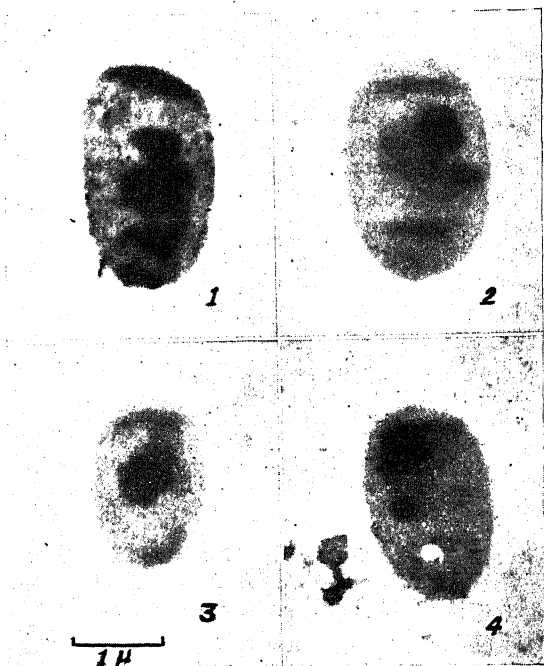
In bacteria the cytoplasm has a strong affinity for basic dyes resulting in difficulties in demonstration of the chromatinic structures. This practical difficulty was overcome by mild hydrolysis.<sup>1</sup> Hydrolysis of yeast cells was therefore carried out to discover whether such a treatment would make the cytoplasm transparent to an electron beam.

The strain of yeast used was the riboflavin excreting mutant, BY 2.5. Young cells from wort cultures at 23°C. fixed in 40% neutral formaldehyde for 1 hour and stored in 5% formaldehyde for 3 days were washed for 3 hours in repeated changes of distilled-water and hydrolysed in  $\text{NH}_4\text{Cl}$  for 12-15 minutes. Small droplets of distilled-water suspension of cells were transferred to supporting membranes of Formvar on specimen carriers, dried and examined with a Philips three-stage electron microscope operating at 60 KV. The cells were viewed on the fluorescent screen at 10,000 diameters and photographed at a quarter of that magnifi-



cation on Kodak 35 mm. safety positive film. The negatives were enlarged six times.

The progressive removal of opacity could be seen in Figs. 1, 2, 3 & 4. The removal is not



FIGS. 1-4

uniform but in patches. Attention is invited to the spherical electron opaque body in Fig. 3 which reminds one of the nucleus described from stained preparations. While the impenetrability of the cytoplasm to the electron beam makes a study of all the cell organelles difficult, the fact that hydrolysis removes the opacity offers the hope that investigation of the nucleus and its behaviour during cell division may be possible.

We are thankful to Dr. M. K. Subramaniam for his encouragement.

(MISS) SARASWATHY ROYAN.

Cytogenetics Lab.,  
Dept. of Biochemistry, and

D. L. BHATTACHARYA.

Dept. of Metallurgy,  
Indian Institute of Science,  
Bangalore-3, April 2, 1956.

## DIGESTIVE ENZYMES OF *MARTESIA STRIATA* LINN.

EVEN though much work has been done on the digestive enzymes of bivalve molluscs by a number of workers,<sup>1-7</sup> very little is known about the digestive enzymes of wood-boring molluscs. Harrington<sup>8</sup> and Boynton and Miller<sup>9</sup> detected amylase and cellulase in the digestive diverticula of *Teredo* and *Bankia*. Nair<sup>10</sup> studied the digestive enzymes of *Bankia indica*. However, no work has been done on the digestive enzymes of *Martesia striata*, which is an important wood-boring bivalve in tropical waters.

The present note describes the results of experiments to determine the nature and action of the digestive enzymes of *Martesia striata*, the common wood-borer, destroying wooden jetties in Visakhapatnam Harbour. Extracts of the digestive diverticula and crystalline style were made as per standard methods.<sup>11</sup> The activity of the enzymes on carbohydrates was determined by methods used by Yonge<sup>12</sup> and Somogyi.<sup>13</sup> The products of fat digestion were estimated by the direct titration of the fatty acid formed with sodium hydroxide solution using phenolphthalein as the indicator and products of protein digestion by Sörenson's formol titration method. In the enzymic experiments the pH of the medium was controlled by suitable buffers, namely, Sörenson's M/15 phosphate buffer pH 5.3 to 7.7 for carbohydrates, M/10 citric acid, M/5 sodium phosphate buffer of McIlvaine, pH 3 to 6.6 followed by 0.2N phosphate-sodium hydroxide buffer of Britton and Welford pH 6.6 to 12.2 for protein and the method adopted by Nicol<sup>14</sup> for fat digestion. The temperature was maintained by an electrically controlled thermostat.

The results of these experiments showed that the digestive system of *Martesia striata* is effective on carbohydrates, fats and proteins. The digestive diverticula were found to contain a strong enzyme system which can hydrolyse a variety of carbohydrates like maltose, sucrose, lactose, raffinose, starch and glycogen but not regenerated filter-paper, sawdust and cotton-wool. The activity-pH curve when plotted for the action of amylolytic enzyme showed that the digestive activity is at its maximum at pH 5.9. A series of experiments to determine the relation between optimum pH and duration of experiment showed that the pH at which digestion is optimum is not changed when the period of incubation is continued from 8, 16, 24 and 32 hours. The temperature of destruction for amylase is found to be between 65°C.

1. Agar, H. D. and Douglas, H. C., *J. Bacteriol.*, 1955, 70, 427.

2. Bartholomew, J. W. and Levin, R., *J. Gen. Microbiol.*, 1955, 12, 473.

3. — and Mittler, T., *J. Bacteriol.*, 1953, 65, 272.

4. Piekarski, G., *Arch. Mikrobiol.*, 1937, 8, 428.

5. Royan, S., *Ibid.*, 1953, 19, 267.

and 70° C. Similar experiments with extracts of crystalline style showed the presence of a strong amylase (optimum pH 5.5), maltase and lactase but not cellulase. Style amylase is also found to be destroyed between 65-70° C.

The lopoclastic enzymes present in the digestive diverticula of *Martesia* though weak, are able to act on methyl acetate, amyl acetate, olive oil and lecithin. The optimum pH of the lipase is found to be 7.6 and the enzyme is destroyed at about 70° C. The protease, just as in other bivalves, is very weak but is capable of acting on different types of proteins like gelatin, fibrin, casein and peptone. The results of experiments with peptone as substrate showed that the protease possesses two optimal pH values, pH 4.0 and 8.5, and it is completely destroyed at 70° C.

The absence of cellulase both in the digestive diverticula and crystalline style is significant as it confirms the idea that *Martesia striata* bores into the wood for the sake of shelter alone and has not the capacity to digest the wood, unlike the shipworms, *Teredo* and *Bankia*.

A full account will be published elsewhere. This work has been carried out with funds provided by the Forest Research Institute, Dehra Dun, specially obtained from various sources for the execution of the scheme on the protection of timber against marine-boring organisms attack.

Dept. of Zoology, P. N. GANAPATI.  
Andhra University, R. NAGABHUSHANAM.  
Waltair, February 20, 1956.

## TWO FUNGAL INFECTIONS OF HEVEA SEEDS

SEVERAL consignments of *Hevea* rubber seeds, imported last year from Malaya by planters in South India, were examined at the Plant Quarantine Station, Madras. Occasionally, pycnidia of *Botryodiplodia theobromae* Pat. and *Phomopsis heveae* (Petch) Boedijn were noticed on the seed-coat, in or near the region of the micropyle and hilum or along the raphe. *P. heveae* was also often observed on rubber leaves entrapped in the packing material. Both fungi have hitherto not been described on the seeds, though a rapid deterioration of seeds in Sumatra, was once<sup>2</sup> ascribed to the former fungus.

Pycnidia of *B. theobromae* were large, markedly erumpent, dark brown or black, separate or grouped together. In the consignments examined here, often about 10% of the seeds were found to be affected by a rot attributable to the fungus, which was isolated from diseased seeds, in pure cultures, on several occasions.

Pycnidia of *P. heveae* were minute, scattered, dark, more or less globose and erumpent. Usually, both 'A' and 'B' spores were present, hyaline and unicellular, the former short, more or less elliptical, and the latter long, slender, mostly uncinat, and measured  $6-10 \times 2-2.5 \mu$  and  $16-30 \times 1-2 \mu$  respectively. This fungus was earlier reported only on dead rubber branches from Sumatra<sup>1</sup> and Ceylon,<sup>3</sup> but is also said to incite dieback in young seedlings in Java.<sup>4</sup>

Spores of *B. theobromae* and 'A' spores of *P. heveae*, from pycnidia on the seeds, germinated in ordinary distilled water at about 25° C., within 2-4 and 20 hours respectively. If the seeds were lightly sprayed with commercial formalin, diluted with an equal amount of water, in a fine mist, and kept covered for 4 hours followed by thorough aeration, no germination of spores was observed even after 48 hours. Preliminary trials indicated that the viability of healthy seeds was not adversely affected by this treatment.

Under the existing regulations of the Destructive Insects and Pests Act of 1914, import of *Hevea* seeds into India is prohibited from America or West Indies except by the Director of Agriculture, Madras, while from other countries it is permitted after inspection and, if necessary, treatment at the port of entry. The consignments of *Hevea* seeds from Malaya, referred to herein, were thoroughly cleaned of all leaves and other plant debris, and later given the formaldehyde treatment, indicated above,

1. Yonge, C. M., *J. Exptl. Biol.*, 1923, **1**, 15.
2. Sawano, E., *Sci. Rep. Tohoku Univ.*, Ser. IV, 1929, **4**, 327.
3. Graham, A., *Proc. Roy. Soc. Lond.*, 1931, **108B**, 8495.
4. Takatsuki, S., *Quart. J. Micr. Soc.*, 1934, **76**, 379.
5. Fox, D. L. and Marks, G. W. et al., *Bull. Scripps. Inst. Oceano*, 1936, **4**, 1.
6. Lavine, T. F., *J. Cell. and Comp. Physiol.*, 1946, **28**, 183.
7. Newell, B. S., *J. Marine Biol. Assoc.*, 1953, **32**, 491.
8. Harrington, C. R., *Biochem. J.*, 1921, **15**, 736.
9. Boynton, L. C. and Miller, R. C., *J. Biol. Chem.*, 1927, **75**, 613.
10. Balakrishna, Nair, N., *Curr. Sci.*, 1955, **24**, 126.
11. Summer, J. B. and Somers, G. F., *Chemistry and Methods of Enzymes*, 1947, Academic Press, New York.
12. Yonge, C. M., *J. Marine Biol. Assoc.*, 1926, **14**, 293.
13. Somogyi, M., *J. Biol. Chem.*, 1930, **86**, 655.
14. Nicol, E. A. T., *Trans. Roy. Soc. Edin.*, 1930, **56**, 537.

prior to release. Nevertheless, it is desirable that the plants raised from all such imported seed be subject to post-entry inspection and outbreak of any disease promptly dealt with.

The author is grateful to Shri K. N. Kaimal, Rubber Production Commissioner, for kindly confirming the identity of rubber leaves, and to Dr. P. R. Mehta of this Directorate, for helpful suggestions in the preparation of the manuscript.

Directorate of Plant S. N. S. SRIVASTAVA.  
Protection,  
Quarantine and Storage,  
Plant Quarantine Station,  
Madras-1, January 7, 1955.

1. Boedijn, K. B., *Recueil Trav. Bot. Neerlandais*, 1929, 26, 396 (*Rev. appl. Mycol.*, 1930, 9, 561).
2. La Rue, C. D. and Bartlett, H. H., *Papers Michigan Acad. Science, Arts and Letters*, 1923, 91.
3. Petch, T., *Ann. Roy. bot. Gard., Peradeniya*, 1917, 6, 195.
4. Soetardi, R. G., *Arch. Rubbercult.*, 1949, 26, 279 (*Rev. appl. Mycol.*, 1949, 28, 589).

#### BENTHIC ORGANISMS OF A FRESH-WATER FISH-TANK

IN the course of investigations on the bottom-fauna of fresh-water bodies, which constitute the chief food of the carnivorous bottom feeding fishes, there was noticed a marked variation in its composition during different periods of the year, both qualitatively and quantitatively. The investigations in related fields of the subject made by Bristow,<sup>1</sup> Samuel,<sup>2</sup> and Seshappa<sup>3</sup> are mainly limited to marine regions. No doubt Hora<sup>4</sup> studied the nature of substratum as an important factor in the ecology of the torrential fauna, and Srivastava<sup>5</sup> gave some observations on the subject, but to my knowledge no detailed qualitative and quantitative data on fresh-water benthic organisms, are available for India in general and Uttar Pradesh in particular.

In order to secure data necessary for the study of benthic fauna, regular weekly collections were made with the help of a simple scoop type bottom sampler. Each sample was later fractionated by means of a modified Lea-Gibbon's subsampler, and only one-tenth of the collection was taken and passed through graded sieves, the excess of water being allowed to pass out. The organisms were finally collected from each of the sieves and qualitative and quantitative estimations made.

The bottom of the fish-tank under examination consisted mainly of soft mud mixed with

fine sand. The atmospheric temperature along with the temperature of the water, brought remarkable changes in the total volume and the percentage composition of the bottom organisms. During monsoon the water registered a high level, but it experienced a gradual decline in winter, till finally it reached the minimum level in summer and a long strip of the bottom was left exposed to air and sun, which brought a large-scale mortality in a majority of the benthic fauna. In the next monsoon season, the water-level registered an increase due to the rains and local drainage of the water, and the exposed strip was again submerged.

The quantitative data reveal that the total volume of bottom fauna was highest during the monsoon months. This peak was mainly due to the abundance of molluscs and oligochaetes. After this monsoon peak there was a fall in total volume, till it reached the minimum level in winter months (Fig. 1). How-

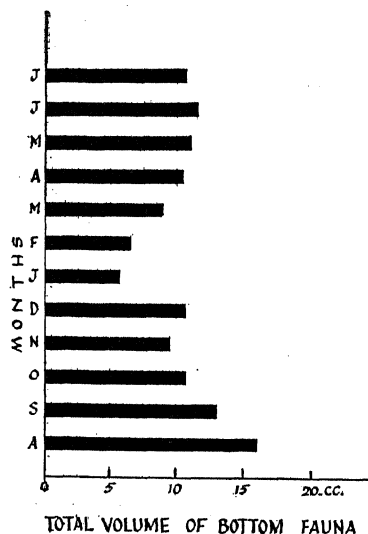


Fig. 1

ever, in spring the volume experienced an increase again due to the abundance of oligochaetes. During summer months there was a decline in the total volume of the bottom samples, which was still further lowered due to exposure to air and hot sun.

It has been observed that fresh-water oligochaetes (*Dero*, *Nais*, *Chaetogaster*, and *Aeolosoma*) constituted the main bulk of the samples during the year, but there was a general increase during the monsoon and summer months (Fig. 2). *Chironomus* larvae although present throughout the year, were found in

largest numbers during winter months. Large gastropods and bivalves were almost uniformly represented, but their percentage was reduced during winter season. Small snails (*Planorbis*)

I am grateful to Dr. S. M. Das for valuable guidance during the conduct of the work.

Dept. of Zoology, VINAY K. SRIVASTAVA,  
Lucknow University,  
Lucknow, February 3, 1956.

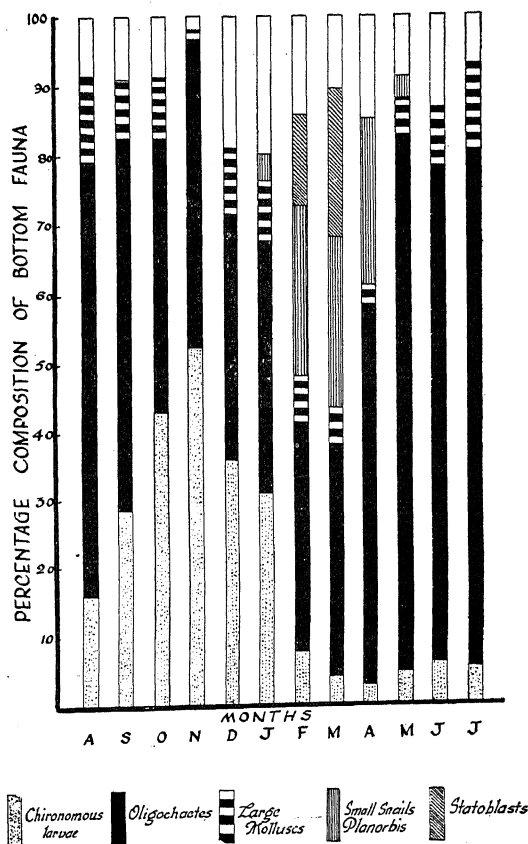


FIG. 2

Unshaded portion—Miscellaneous

were however present in good numbers in winter, while nymphs of dragonflies were also common. A few leeches were also represented during the year. Ostracods and some aquatic insects were collected from samples throughout the year.

It is quite evident from the observations recorded above that the benthic fauna was quantitatively lowest during winter months and highest during the monsoon. Unlike the plankton, which has two peaks,<sup>6</sup> the bottom fauna has only one peak during the year. Investigations on the ecology of this large assemblage of burrowers, clingers, crawlers and hidiers among bottom materials, are being continued and fuller results will be published later. The present results have important correlation with the food of bottom feeding fishes of Uttar Pradesh<sup>7</sup> which are being investigated separately.

1. Bristow, R. C., *History of Mud Banks*, 1938, 1 & 2, Cochin Govt. Press, Ernakulam.
2. Samuel, M., *Jour. Mad. Univ.*, 1944, 15, 45.
3. Seshappa, G., *Proc. Nat. Inst. Sci. India*, 1953, 19, 257.
4. Hora, S. L., *Ibid.*, 1936, 2, 45.
5. Srivastava, V. K., *Nat. Acad. Sci. (Abstract)*, Silver Jub., 1955 (In press).
6. Das, S. M. and Srivastava, V. K., *Proc. Ind. Sci. Congr.*, 1956, 320.
7. — and Moitra, S. K., *Curr. Sci.*, 1955, 12, 417.

### USE OF ORGANO-MERCURIAL FUNGICIDE AS SETT TREATMENT FOR SUGARCANE

THE use of *Aretan*, an organo-mercurial fungicide, has been reported by Mc. Martin<sup>1,2</sup> to afford protection to sugarcane setts from pineapple disease, as also for improving the rate and extent of germination under dry soil conditions in South Africa even when the disease did not exist. This was attributed to a prevention of the ingress of soil micro-organisms through the cut ends which constituted a drain on the moisture and nutrient reserves of the sett and caused production of toxins as a result of fermentation. Similar results were obtained in Mauritius,<sup>3</sup> Queensland<sup>4</sup> and Louisiana.<sup>5</sup> Under North Indian conditions, lack of soil moisture is a factor seriously retarding germination and these studies were accordingly undertaken with a view to exploring the possibilities of *Aretan* in this connection.

The trials were laid out on a field scale in three replications at Pusa in North Bihar (light calcareous loam), the treatments involving three concentrations of the chemical (1, 2 and 4 oz. per 10 gallons) each under five durations of soaking, viz., dip in and out and soaking for 15, 30, 45 and 60 minutes. A parallel series was run with water instead of *Aretan* solutions along with "no treatment" as control. The results showed: (i) All treatments improved per cent. germination significantly as compared to control. (ii) The highest figure of 36.1% was obtained under dip in and out treatment with 4 oz. concentration of *Aretan* followed by 15 minutes' soaking at the same concentration (34.3%) as against 14.8% in control. (iii) The period of soaking needed for greatest improvement in germination tended to decrease with increase in concentration of the fungicide.

(iv) In contrast to the above, the rate of germination under control was superior to all treatments and significantly so in most cases. (v) Growth, yield and juice quality data did not show any significant or systematic differences.

It would thus appear that considerably improved germination results from use of Aretan, the best performance being recorded with dip in and out treatment in a solution containing 4 oz. of the chemical in 10 gallons water. Further work is in progress.

The work forms part of the Sugarcane Research Scheme in Bihar being financed jointly by the Government of Bihar and the Indian Central Sugarcane Committee to whom grateful thanks are due.

Central Sugarcane Res. M. S. SUBBA RAO.  
Station, Pusa (Bihar), N. S. NEGI.  
October 30, 1955. K. L. KHANNA.

1. Martin, Mc., *S. African J. Sci.*, 1946, 2A, 122.
2. —, *S. African Sug. J.*, 1949, 651.
3. Evans, H. and Wiehe, W. O., *Mauritius Sug. Res. Sta. Bull.*, 1947, No. 19.
4. Anon, *World Crops*, 1953, 5, 497.
5. Mills, P. J. and Chilton, S. J. P., *Proc. Internat. Soc. Sugarcane Tech. 7th Congr.*, 1950, 197.

### PSEUDONAPOMYZA ATRA ON MAIZE LEAVES

MAIZE leaves were mined by the maggots of *Pseudonapomyza atra* (Meigen), (Phytomyzinae, Agromyzidae) at Himayatsagar Farm during 1952. Since then the fly has been noted throughout the Hyderabad State. The mines are usually linear, measuring from 2 to 10 cm. long and 1 to 1.5 cm. wide. Sometimes the mines coalesce and form a blotch and become wider. When fresh, the mines appear light green, but on drying become brown and finally white. If the attack is in the early stage of the crop, the severely mined leaves may dry up and drop off the plant.

Maggots are solitary miners but more than one maggot per mine was noticed, and in a few cases 5 maggots were found in a single mine. The yellowish white maggots mine between the epidermal layers of the leaf. If a mine is held to light, the extent of mine and the maggot inside can easily be seen. Generally the maggot works from the tip of the leaf toward the base, although mining from base toward apex is seen in a very few cases.

Frass was found scattered in the mine. No puparia were found in the tunnel nor on the leaves. Before pupation, mature maggots cut

slits in the tunnel and come out for pupation in the soil. Sometimes black specks are found in the mines which can be mistaken for puparia; on examination, however, it will be found that these are parasitized maggots and are dying. The leaf miner attacks the leaves in all the stages of plant growth.

A random counting of mined maize leaves of 1½-months-old crop showed 10-30% attack. Usually 1 mine per leaf is found, but more than 1 mine per leaf up to a maximum of 5 were also noted. Mines were more numerous during September-October, however, the activity of the leaf miner is noticed throughout the year. As far as this writer is aware, this pest is reported for the first time from India.

The adult is a medium-sized fly, black marked with yellow. Maggots are yellowish white and robust. Puparium is formed outside the tunnel and is light brown to dark brown.

Parasites, *Derostenus* sp., *Achrysocharis* sp. (Eulophidae), and *Eucoilidea* sp. (Eucoilinae), were reared from *Pseudonapomyza atra* larvæ.

This leaf miner was collected from paddy and *Cynodon* leaves also.

Grateful acknowledgements are made to Dr. Kenneth E. Frick for identifying the leaf miner and to Dr. C. F. W. Muesbeck for arranging the identification of parasites. Gratitude is expressed to Dr. M. Q. Kahn for facilities.

Main Experimental Farm, D. BAP REDDY.  
Rajendranagar,  
Hyderabad State, March 13, 1956.

### ON METHYL BROMIDE AS A PLANT FUMIGANT

METHYL BROMIDE (bromo-methane—CH<sub>3</sub>Br) has been officially recognised in America as an effective insecticidal fumigant. Because of its remarkable penetrating qualities, it is used in flour mills, warehouses, ships, goods wagons, etc.<sup>1,2</sup> It is also employed for the treatment of non-foliated plant materials such as corns, tubers, bulbs, fruits, etc.<sup>1</sup> It is, however, not recommended for fumigating green-house plants although certain herbaceous types as ferns, etc., were "successfully put under its influence".<sup>3</sup> English and Turnipseed<sup>4</sup> studied the reaction of the various kinds of nursery stock to methyl bromide and have recorded that certain plants were partially or completely defoliated but not killed by the chemical, whereas certain others were seriously injured by its effect. No grass or a monocot seems to have come under their study (also vide Anon<sup>5</sup>).

In conformity with the recommended procedure for plant quarantines in this country, cuttings of *Saccharum spontaneum* imported from abroad were subjected to fumigation with methyl bromide at a concentration of 25 c.c. of the liquid per 50 c.ft. of space for 1½ hours at room temperature, followed by hot water treatment at 52° C. for 20 minutes before planting in the quarantine shed. The buds of the cuttings thus treated germinated more or less normally, but the sprouts subsequently began to dry up. An examination showed that the death and drying up of the sprouts was due to the failure of the cuttings to root properly. All the root primordia had blackened, and such of the roots as had been formed had also died off. Some valuable material imported from foreign countries was thus lost.

As the material had received more than one phytosanitary treatment, in order to locate the cause of the destruction of the root eyes, a small experiment was conducted. Cuttings of six variants of *S. spontaneum* were subjected to the following pre-planting treatments: (1) no treatment (control); (2) fumigation with methyl bromide at the concentration given above; (3) soaking in hot water at 52° C. for 20 minutes; and (4) fumigation and hot water treatment as in (2) and (3). After these treatments, the cuttings were planted in sterile soil.

Observations showed that wherever methyl bromide was used, the initial germination, sett-root formation, and normal growth of the sprouts were adversely affected. In the control, as also in the hot water treatment without fumigation, germination and rooting were normal.

Varieties differed a little in the extent of their susceptibility to methyl bromide; in two varieties rootlets were formed before the effect of the fumigant set in; in four, the root eyes themselves were killed off. In the case of two variants, germination of buds was also completely arrested.

It appears from this that at least so far as *S. spontaneum* is concerned, serious damage is caused by the use of methyl bromide. It seems advisable, therefore, to exercise great caution in the treatment of grass-stalks with this fumigant.

We are grateful to Shri R. R. Panje for encouragement and guidance, and to Shri R. A. Agarwal and Shri K. V. Srinivasan for help in giving the treatments.

Sugarcane Breeding Inst., J. T. RAO.  
Lawley Road, Coimbatore, A. S. ETHIRAJAN.  
March 7, 1956.

1. Frear, D. E. H., *Chemistry of Insecticides, Fungicides and Herbicides*, 1948, D. van Nostrand Co., New York.
2. West *et al.*, *Chemical Control of Insects*, 1951, Chapman and Hall, London.
3. Hough, W. S. and Mason, A. F., *Spraying, Dusting and Fumigating Plants*, 1951, The McMillan Co., New York.
4. English, L. L. and Turnipseed, G. F., *Ala. Agr. Expt. Sta. Cir.*, 1946, 93 (Quoted by Hough and Mason).
5. Anon, *Methyl Bromide—A Review of the Literature*, 1946, May & Baker Ltd., Dagenham, England.

### CYTOLOGY OF THE OPHIOGLOSSACEAE

FROM a critical study of over a dozen tropical species of *Ophioglossum*, one of *Botrychium* and the monotypic *Helminthostachys*, it has been possible to arrive at important findings regarding the cytology of the Ophioglossaceae. The results of this study are reported in detail elsewhere. The purpose of the present note is to establish the lowest haploid number in the genus *Ophioglossum* and to postulate the probable basic number of the Ophioglossaceae.

*O. costatum* R. br. (*O. fibrosum* Schum.).—Cytological examination of spore mother cells of this species collected from Palghat showed the presence of 120 bivalents at metaphase of meiosis (Fig. 1). Identical results have been

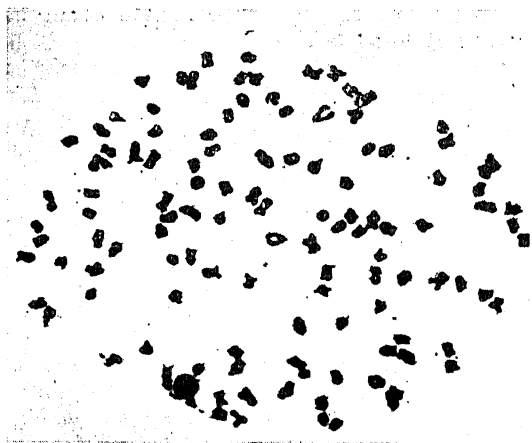


FIG. 1. Metaphase of first meiotic division in a spore mother cell of *Ophioglossum costatum* R. br.  $n=120 \times 750$ . obtained from three other species of *Ophioglossum* collected from different places in India.

*O. lusitanicum* L. (Locality, Tambaram).—This plant showed exactly 240 bivalents at meiosis (Fig. 2). Clear counts of 240 bivalents

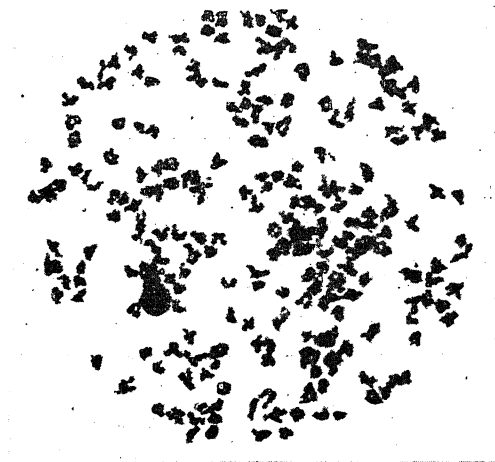


FIG. 2. Similar stage in *O. lusitanicum* L.  $n = 240$ ,  $\times 750$ .

were also obtained from several varieties of *O. nudicaule* obtained from different localities.

Previous reports of chromosome numbers in this genus indicate the presence of  $n = 125 - 130$  in *O. lusitanicum* and  $n = 250 - 260$  in *O. vulgatum*.<sup>1</sup> The present observations clearly show that the lowest haploid number in the Indian species is exactly  $n = 120$ . In the light of this finding, it seems desirable to re-examine with more abundant material other species of *Ophioglossum* in which only approximate count has been possible so far.

Observations on materials of *Helminthostachys zeylanica* (L.) Hk. collected from Trivandrum showed 94 bivalents at meiosis and 188 chromosomes in root tip cells. *Botrychium lanuginosum* Wall. from Ootacamund gave a somatic chromosome count of  $2n = 180$ .

Comparing the lowest haploid numbers in *Ophioglossum*, *Botrychium* and *Helminthostachys*, it will be seen that all the three genera are traceable back to simpler and identical cytological beginnings. In *Botrychium* there is a polyploid series based on the haploid number  $n = 45$ ,<sup>1-3</sup> while the monotypic *Helminthostachys* has a haploid number of  $n = 94$ . Excepting the single instance of *B. virginianum* with  $n = 91$  or  $92^3$  and *Helminthostachys*, the above-mentioned species of *Ophioglossum* and all species of *Botrychium* are seen to centre round a basic number of 15. Britton's observation of the existence of aneuploidy in the American *B. virginianum* (Muhl.) Fern.

lends support to the possibility that in *Helminthostachys* also aneuploidy at an earlier stage might have given rise to a number which is slightly higher than a multiple of 15. It therefore seems plausible that in spite of the apparent discrepancy in chromosome number, *Helminthostachys* also with *Botrychium* and *Ophioglossum* shares the basic number of 15; and while the two former genera have become stabilised at comparatively low levels of polyploidy, the latter has succeeded in attaining very high levels of polyploidy, up to the sporophytic number of  $2n = 1,260$ ,<sup>4</sup> the highest chromosome number yet reported in any species.

The author is indebted to Prof. A. Abraham for guidance and encouragement.

Dept. of Botany,  
Travancore University,  
Trivandrum, March 2, 1956.

C. A. NINAN.

1. Manton, I., *Problems of Cytology and Evolution in the Pteridophyta*, 1950, London, Cambridge University Press.
2. — and Sledge, W. A., *Phil. Trans. "Roy. Soc."*, 1954, **230 B**, 127.
3. Britton, D. M., *Amer. J. Bot.*, 1953, **40**, 575.
4. Abraham, A. and Ninan, C. A., *Curr. Sci.*, 1954, **23**, 213.

#### DEVELOPMENT OF ENDOSPERM AND NUCELLAR POLYEMBRYONY IN *AEGLE MARMELOS* CORREA

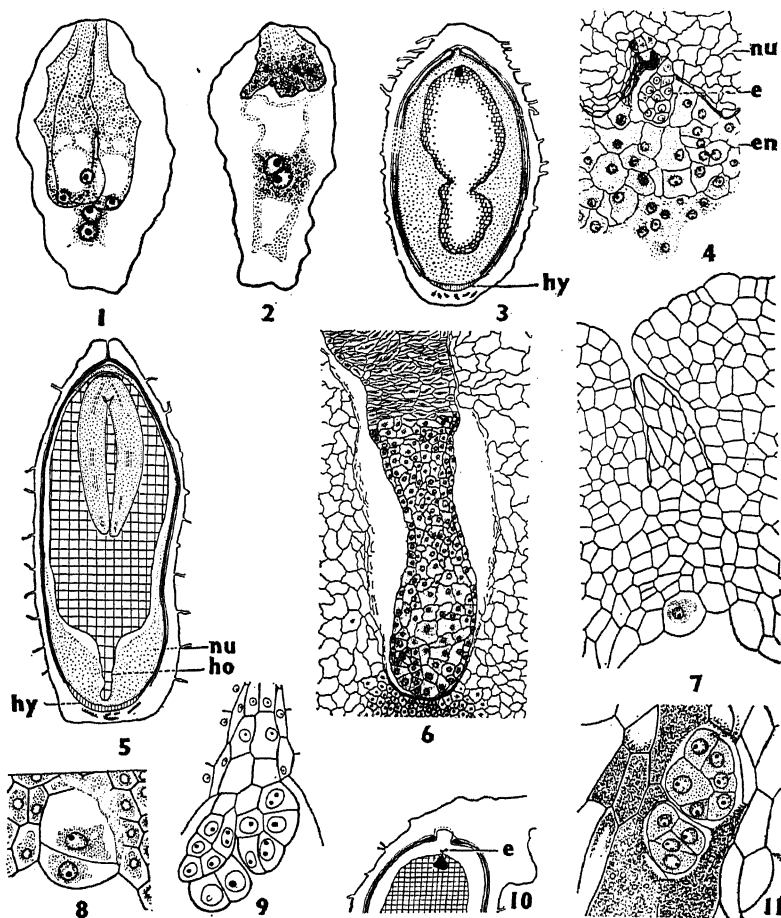
CHAKRAVARTHY<sup>3</sup> reported in this journal that "nucellar embryos are very rarely found in *Aegle* and even then they seem to stop development at a very early stage....." Out of a large number of young seeds examined by him, only two cases of nucellar embryos were noticed. Since our observations do not support this, a brief account of the endosperm and embryos is presented below.

There are nearly 200 ovules in the ovary but approximately 75% contain degenerated gametophytes. In most of the remaining embryo-sacs the antipodal cells disorganize first (Fig. 1) followed by the egg apparatus, so that only the polar nuclei remain in a healthy condition (Fig. 2). Syngamy has not been observed, and even before the entry of the pollen tube the egg is usually in a degenerated condition. However, triple fusion probably occurs normally.

The endosperm is Nuclear. When approximately 256 endosperm nuclei have been formed, some of them aggregate at the chalazal end of the embryo-sac. Centripetal wall formation is initiated at the micropylar end and pro-

gresses downwards (Figs. 3, 4). An interesting feature is the development of an elongated chalazal process which digests the surrounding tissue (Figs. 5, 6). Mauritzon<sup>4</sup> observed a similar tubular projection in *Empleurum serrulatum*, *Coleonema album*, *Ptelea trifoliata* and *Triphasia aurantiola*.

oblique division (Fig. 8). Subsequent divisions are irregular resulting in the formation of an embryonal mass which projects into the cavity of the gametophyte where it undergoes further development. As many as three such masses, at different stages of development, have been observed in a single embryo-sac



FIGS. 1-11. *e*, nucellar embryo; *en*, endosperm; *ho*, chalazal process; *hy*, hypostase; *nu*, nucellus; the cross-hatched region in Figs. 3, 5 and 10 represents the cellular endosperm. Fig. 1. Embryo-sac with egg-like synergids and polar nuclei; the antipodals have degenerated,  $\times 500$ . Fig. 2. Same, only the polar nuclei are healthy,  $\times 500$ . Fig. 3. L.s. ovule showing centripetal wall formation in endosperm (diagrammatic),  $\times 10$ . Fig. 4. Magnified view of a nucellar embryo and endosperm,  $\times 200$ . Fig. 5. L.s. young seed with endosperm haustorium (diagrammatic),  $\times 8$ . Fig. 6. Enlargement of haustorium and adjacent nucellar cells from Fig. 5,  $\times 50$ . Fig. 7. Micropylar portion of ovule, one of the nucellar cells is enlarging into the embryo-sac cavity,  $\times 300$ . Fig. 8. Two-celled nucellar embryo,  $\times 375$ . Fig. 9. Three adventive embryos,  $\times 375$ . Fig. 10. L.s. upper half of the ovule with two smaller (*e*) and one larger (black) nucellar embryo,  $\times 9$ . Fig. 11. Enlarged view of the two smaller nucellar embryos shown at *e* in Fig. 10,  $\times 375$ .

While the endosperm is still in the free nuclear condition, one or more of the nucellar cells at the micropylar end, particularly those bordering the embryo-sac, become richly cytoplasmic (Fig. 7). The 'plasma-rich' cell (or cells) undergoes a transverse or a slightly

(Figs. 9-11). The nucellar embryos exhibit varying degrees of fusion, especially in the basal region.

Although several nucellar embryos may develop concurrently for a time, eventually one of them takes the lead and passes through the



globular and heart-shaped stages. The mature embryo is typically dicotyledonous and occasionally the massive cotyledons may be unequal. While the possibility of zygotic embryos cannot be ruled out, none of our preparations gave any evidence of it.

Attention may now be called to some other reports of polyembryony in the Rutaceae. One zygotic and two or more nucellar embryos are formed in *Citrus*<sup>5,6</sup> species. In *C. paradisi* and *C. aurantium*,<sup>1</sup> besides the nucellar embryos, polyembryony is also due to the production of zygotic embryos from multiple gametophytes. Nucellar embryony also occurs in *Murraya koenigi*,<sup>2</sup> *M. exotica*,<sup>3</sup> *Ptelea trifoliata*,<sup>4</sup> *Xanthoxylum bungei*<sup>4</sup> and *Triphasia aurantiola*.<sup>4</sup> In the last two species, a zygotic embryo is present side by side with the nucellar embryos.

Grateful thanks are due to Prof. P. Maheshwari for criticism and advice.

Dept. of Botany,  
University of Delhi,  
March 24, 1956.

B. M. JOHRI.  
M. R. AHUJA.

1. Bacchi, O., *Bot. Gaz.*, 1943, **105**, 221.

2. Chakravarthi, R. S., *Curr. Sci.*, 1935, **3**, 361.

3. —, *Ibid.*, 1936, **5**, 202.

4. Mauritzon, J., *Svensk. bot. Tidskr.*, 1935, **29**, 319.

5. Osawa, J., *J. Coll. Agric. Tokyo*, 1912, **4**, 83.

6. Strasburger, E., *Z. Naturw. Jena*, 1878, **12**, 647.

### SCILLA INDICA IN INDIA

*Scilla indica* Baker exhibits a high degree of multiformity in India, which has hitherto not been fully unravelled. An extensive study leading to an integration of morphological, cytological and distributional data has provided a full answer to the same. It is now reasonably clear that the underlying cause of its variation is the occurrence of chromosome races or cytotypes with  $2n = 30, 44, 45^3, 46^3, 58^5$  and 60 chromosomes.

A critical study of the karyotype of plants with  $2n = 30$ , in comparison with the other available chromosome numbers in the genus,<sup>1</sup> leads one to think that they might have had an allopolyploid origin and hence are functional diploids. Based on the number 30, triploids with 45 and tetraploids with 60 somatic chromosomes are built up. The precise mode of origin of these forms is not yet clear. It is, however, possible to detect certain similar chromosome types in all the three karyotypes. Plants with 44, 46 and 58 somatic chromosomes referred to above are probably aneuploids at triploid and tetraploid levels. They may also be straight ploids based on 30.

Facts gathered from meiosis in PMCs fully affirm some of the above-mentioned conclusions. The functional diploids are usually characterised by the formation of 15 bivalents and regular disjunction, thereby ensuring good pollen fertility. The hypotriploids ( $2n = 44$ ) show a variable number of trivalents, bivalents and univalents and are wholly sterile. The tetraploids show all types of configurations, the highest being tetravalents. It is, indeed, remarkable to observe that, despite the high chromosome number, tetraploids exhibit a greater tendency towards the formation of bivalents than tetravalents. This perhaps explains why to some extent they are propagated by seeds, although seed-setting is not so regular as in diploids. Multivalent formation in triploids and tetraploids is probably responsible for the origin of the aneuploid plants mentioned above (cf. Müntzing<sup>2</sup>).

This general chromosome survey, although incomplete in itself, nevertheless tells us that the evolutionary pattern in *Scilla indica* is determined by the establishment of the chromosome number 30 through polyploidy and subsequent hybridisation resulting in an array of morphologically more or less similar forms with different chromosome numbers. All these cytotypes have escaped the attention of the systematists so far.

When cytological results are combined with the taxonomic problem, the population of *Scilla indica* resolves itself into two natural groups. The diploids and tetraploids form one group, having almost similar morphological features. The triploids, on the other hand, form a group of their own and can readily be recognised on account of their linear-lanceolate leaves not encountered in the first group. Bulbils, so characteristically found at the tip of every leaf of the triploids, have not been observed in diploids and tetraploids. When all these facts are put together, the status of the diploids and triploids as species becomes indisputable. The taxonomic status of the tetraploids, however, is not yet clear.

Not only do chromosome races of *Scilla indica* vary in external morphological features but show characteristic differences in geographic distribution in India. Determination of the chromosome numbers of about 300 plants collected from different localities has revealed that diploid races occur in Bombay, Dharwar, Mysore and extend up to Tiruchirapalli. The triploids exist in the Coromandel Coast from Masulipatam to Madras. The tetraploids are found in the central parts of India (M.P.). The

TABLE I

Chromosome numbers of *Scilla indica*, collected from different localities in India

Locality	2n	Meiosis	No. of plants studied
1 Bombay	30	Mostly II	20
2 Dharwar	30	"	50
3 Mysore	30	"	10
4 Tiruchirapalli	30	Mostly II	40
5 Madras	44	III, II and I	30
6 Masulipatam	44	"	60
7 Madras	45, 46	Frequently III, II, and I; rarely IV, implying autosis	Not known*
8 Sagar	58	"	Very few†
9 Sagar	60	IV, III, II and I; a high frequency of II	60
10 Nagpur	60	"	Few

\* These were reported by Raghavan and Venkatasubban,<sup>3</sup> 1939. † These are very rare in nature.

aneuploids co-exist with their triploid and tetraploid relatives in their respective regions and nowhere else. It is an entirely plausible assumption that polyploid forms arose as a result of hybridisation in Peninsular India, south of the Vindhya and the Satpuras. Hence, this part of Peninsular India is a seat of great evolutionary activity for *Scilla indica*. This closely agrees with the geographic distribution of *Ottelia alismoides* in India (Sundar Rao,<sup>4</sup> 1951). What is more, the fact that these two phylogenetically unrelated species have the same distribution pattern in India is of far-reaching significance.

To some extent, attention was also focussed upon the local variations in different chromosomal populations of *Scilla indica*. Interestingly enough, it shows ecologically adaptive divergence leading to the evolution of ecotypes. For instance, the diploid races occurring in Bombay and Tiruchirapalli are sharply different and so the triploid forms in Andhra and Madras. Whether it is ecotopic or ecoclimatic divergence or both, it still leaves the question open what role these local populations play in the evolution of new species.

Grateful thanks are due to Dr. A. C. Joshi, Prof. R. Misra and Prof. A. Müntzing (Lund, Sweden) for their kind interest in the investigation and to various Indian botanists for supplying the material.

Dept. of Botany,  
University of Saugar,  
Sagar, M.P., India,  
October 24, 1955.

Y. SUNDAR RAO.

1. Darlington, C. D. and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, 1945, London.
2. Müntzing, A., *Hereditas*, 1936, **21**, 263.
3. Raghavan, T. S. and Venkatasubban, K. R., *Cytologia*, 1939, **10**, 189.
4. Sundar Rao, Y., *Curr. Sci.*, 1951, **20**, 72.
5. —, *Sci. and Cult.* 1953, **18**, 336.

### CYTOLOGY OF *GLORIOSA*

THIS liliaceous genus contains about 18 species (*vide* Index Kewensis) which inhabit mountains of tropical Asia and Africa. Some species are often cultivated for their beautiful showy flowers. The rhizomes and seeds could also be utilized as an alternative source for the alkaloid colchicine.<sup>3</sup> The cytology of this genus has received practically no attention so far. Chromosome numbers have been recorded for *G. carsonii*, *G. simplex*, *G. superba* and *G. rothschildiana*.<sup>1,5,6</sup> All the four species are diploid ( $2n = 22$ ). No cases of intra- or interspecific polyploidy have been recorded so far.

Karyotypes of five collections received from M/s. Chandra Nursery, Sikkim, have been investigated. A thorough analysis of meiosis was not possible due to paucity of flowers. Out of these, two are diploid ( $n = 11$ ,  $2n = 22$ ), one tetraploid ( $n = 22$ ,  $2n = 44$ ), one hexaploid ( $n = 33$ ,  $2n = 66$ ) and one octoploid ( $n = 44$ ,  $2n = 88$ ). The diploid types can be referred with certainty to *G. simplex* Linn. (*G. plantii* Loud.) and *G. superba* Linn. The taxonomy of the polyploid types is intricate and is being studied.

Details of this investigation will be discussed in another paper; however, some points deserve mention here. The diploid species have a normal meiosis. These produce normal pollen and set viable seed. In the polyploid types, though most of the associations at diakinesis are bivalents, yet many irregularities like multivalents, univalents, non-disjunction, anaphase bridges, laggards, tetrads with micronuclei and polyads do occur. As a consequence pollen is mostly sterile which results in practically no seed set. Perhaps sterility extends to megaspores also.

The author was able to collect hardly a dozen of seeds in two years from all the polyploid types. Out of these only one seed belonging to tetraploid germinated. This possessed 41

chromosomes ( $4x-3$ ) in root tips. Furthermore, in the tetraploid type a small rhizome of triploid constitution was discovered in 1954. This rhizome has produced a plant which has not flowered so far.

The diploid *G. simplex* resembles the octoploid type except for the size and details of the colour scheme of the flower. It is quite likely that the latter has been evolved, by polyploidy of the former species or its allies. Such a hypothesis cannot be tested since these polyploids are so sterile that they set hardly any seeds after cross-pollinations. The nature of the polyploid types can therefore, be inferred from the meiotic behaviour, karyotype (Figs. 1 & 2) and general morphology.



Chromosomes from root-tips pretreated with 0.0005 mol. solution of 8-O q.

FIG. 1. *Gloriosa simplex*,  $2n = 22$  ( $\times 1300$ ).

FIG. 2. *G. species*,  $2n = 88$  ( $\times 1300$ ).

All the polyploid types though completely sterile, are preserved by efficient vegetative reproduction. For the same reason, balanced or unbalanced polyploidy is rather common in herbaceous perennials.<sup>4</sup> As against this, the sexually reproducing annuals always possess properly balanced polyploids since sterile combinations cannot produce any progeny.

It may be pointed out that this genus contains colchicine and possesses polyploid types in contrast to *Colchicum* which shows an aneuploid series.<sup>2</sup>

I am deeply indebted to Prof. P. N. Mehra for helpful suggestions, and to Mr. B. Khanna for help with the diagrams.

Botany Dept.,  
Panjab University,  
Amritsar, February 20, 1956.

T. N. KHOSHOO.

1. Darlington, C. D. and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, G. Allen & Unwin Ltd., London., 1945.
2. Mehra, P. N. and Khoshoo, T. N., *Curr. Sci.*, 1948, **17**, 242.
3. —, *J. Pharm. Pharmacol.* (England), 1951, **3**, 486.
4. Stebbins, G. L., *Variation and Evolution in Plants*, Columbia Univ. Press, New York 1950.
5. Tjio, J. H., *Hereditas*, 1948, **34**, 135.
6. — and Levan, A., *Ann. Estac. Expert. Aula Dei.*, 1950, **2**, 21.

### THE SYNTHESSES OF HUTTONITE AND MONAZITE

THE syntheses of huttonite and monazite by solid state reactions are here reported. Naturally occurring huttonite (monoclinic  $\text{ThSiO}_4$ ) was discovered quite recently.<sup>1</sup> In attempting to synthesize  $\text{ThSiO}_4$  in either the tetragonal thorite form or the monoclinic huttonite form, it was found that below  $1,300^\circ\text{C}$ .  $\text{ThO}_2$  and  $\text{SiO}_2$  reacted extremely sluggishly or not at all. The X-ray powder diffraction patterns of mixtures below  $1,300^\circ$  were those of thorite and silica. At temperatures slightly above  $1,300^\circ$  X-ray photographs revealed that the lines of thorite slowly faded with the gradual appearance of the lines of monoclinic thorium silicate although the reaction was still slow. It is interesting to note that by the solid state reaction method, the extremely rare naturally occurring monoclinic modification was directly formed and not the abundantly occurring tetragonal thorite.

Huttonite was then most conveniently synthesized by wet mixing under acetone 10.6 g. of  $\text{ThO}_2$  [obtained by igniting extremely pure  $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$  at  $1,200^\circ\text{C}$ . for 12 hours] and 2.6 g. of  $\text{SiO}_2$  (obtained by igniting pure silica gel) and heating the mixture at  $1,500^\circ\text{C}$ . for 96 hours. The mixture was removed from the furnace every 24 hours, pulverized, sieved through 200 mesh to ensure proper mixing and replaced. A 5% excess of silica was used to compensate for the volatilization losses at the high temperature employed.

As an initial attempt to synthesize monazite a single mixture of 95% monoclinic  $\text{CePO}_4$  and 5% huttonite was used. Various methods given in the literature<sup>2</sup> for the preparation of  $\text{CePO}_4$  were tried, but it was most conveniently synthesized by heating an appropriate mixture of

$\text{Ce}(\text{NO}_3)_3 \cdot 4\text{H}_2\text{O}$  and  $(\text{NH}_4)_2\text{HPO}_4$  to about 200°. The resulting  $\text{CePO}_4$  was washed and heated to 700° when it readily changed over to the monoclinic form. 1.90 g. of this monoclinic  $\text{CePO}_4$  and 0.10 g. of huttonite were wet mixed under acetone, dried and the mixture heated at 1,400° C. for 120 hours. During this period the mixture was quenched every 24 hours, pulverized and sieved as before to ensure homogeneity. The resulting mass which is light brown in colour, gave an X-ray pattern, the  $d$ -values of which were intermediate between those of  $\text{CePO}_4$  and  $\text{ThSiO}_4$  and the spacings and the relative intensities of which agreed closely with those of natural monazite. Chemistry Division, M. D. KARKHANAVALA, Atomic Energy Establishment, Bombay, March 20, 1956.

1. Pabst, A. and Hutton, C. O., *Amer. Min.*, 1951, **36**, 60.
2. Mellor, J. W., *A Comprehensive Treatise on Inorganic and Theoretical Chemistry*, 1946, **5**, 675, Longmans, Green & Co., London.

#### OBSERVATIONS OF DIRECT SOLAR AND DIFFUSE SKY RADIATION DURING SOLAR ECLIPSE

THE direct radiation from the sun and diffuse radiation from the sky were measured at Waltair during the solar eclipse on the 14th December 1955, making use of Gorezynski's Solari-meter in combination with Gorezynski's pyrheliometer.<sup>1</sup> Observations were taken at intervals of 10 minutes from just before the eclipse attained its full magnitude (13 hr. 22 min.) till the end (15 hr. 08 min.). Due to a slight dislocation of the original plan, regular recording of observations could not be secured until the eclipse progressed to an appreciable extent; the eclipse started at Waltair at 11 hr. 14 min. I.S.T.

The pyrheliometer gives the direct radiation from the sun's disc while the solari-meter measures the total radiation, i.e., the diffuse radiation from all sections of the sky plus the vertical component of the direct solar radiation. By measuring the zenith distance of the sun by means of a pilot-balloon theodolite, the vertical component of the direct radiation from the sun could be computed from the cosine relation. The diffuse radiation from the sky was then obtained by subtracting the vertical component so computed from the solari-meter reading. The data are shown in Table I and are graphically represented in Fig. 1. For comparison, normal data for a few days in December, just preceding and following the eclipse-day,

are also plotted in Fig. 1. The effect of the eclipse, which has a maximum phase of 0.65

TABLE I

Time in hours I.S.T.	Total radiation	Solar radiation	Zenith distance in degrees	Vertical component of Solar radiation	Diffuse radiation from sky
1310	0.39	0.42	45.0	0.30	0.09
1320	0.34	0.37	46.3	0.26	0.08
1330	0.32	0.41	47.9	0.28	0.04
1340	0.32	0.45	49.0	0.30	0.02
1350	0.34	0.47	50.5	0.30	0.04
1400	0.37	0.50	52.0	0.31	0.06
1410	0.41	0.57	53.7	0.34	0.07
1420	0.43	0.65	55.0	0.37	0.06
1430	0.45	0.70	56.5	0.38	0.07
1440	0.50	0.77	58.6	0.40	0.10
1450	0.50	0.80	60.0	0.40	0.10
1500	0.50	0.85	62.0	0.40	0.10
1510	0.47	0.87	64.0	0.38	0.09
1520	0.44	0.85	65.5	0.35	0.09

Note: All radiation measurements are in gram calories per sq. cm. per minute.

at Visakhapatnam, on the incoming radiation is clearly seen in the figure.

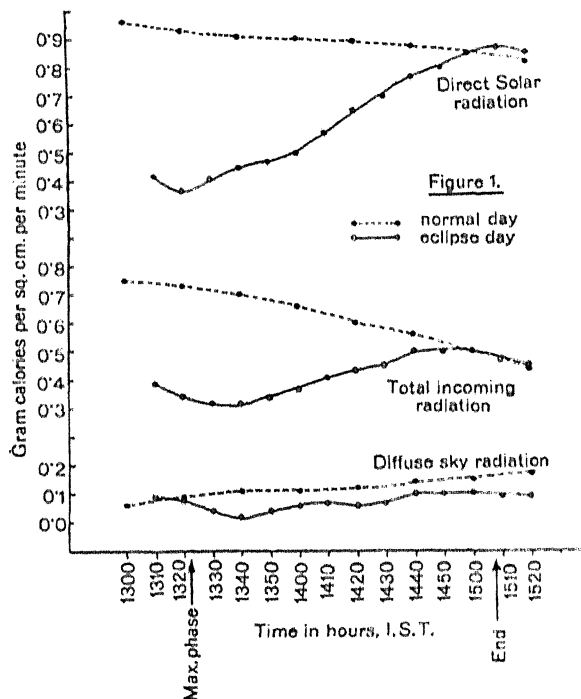


FIG. 1

As one would expect, the direct solar radiation is a minimum (0.37 g. cal./sq. cm./min.) at the time of the eclipse maximum, but the diffuse radiation is not. This is because the diffuse

radiation from the sky increases in amount with increase of the zenith angle of the sun and superposed on this increase is the variation due to the gradual clearing of the solar disc. In the absence of the eclipse, the diffuse radiation would be a minimum at the time of the minimum solar zenith distance (or local noon) while, with no variation in the position of the sun in the sky, the diffuse radiation should be a minimum when the eclipse is at its maximum. When these two effects are superposed on each other it can be seen that the minimum diffuse radiation epoch would accordingly be displaced; the observations show that this is around 1340 hours, I.S.T. The total radiation exhibits a variation that is intermediate between that of the direct solar and diffuse sky radiations.

Dept. of Geophysics, R. RAMANADHAM.  
Andhra University, V. P. SUBRAHMANYAM.  
Waltair, February 24, 1956.

1. Gorczynski, L., *J. Opt. Soc. of Amer. and Rev. Sci. Instrum.*, 1927, 14, 149.

### CYTOLOGY OF INDIAN GLEICHENIACEAE

GLEICHENIACEAE is a primitive family of terrestrial ferns comprising about 130 species<sup>1</sup> and distributed mostly in the tropics and subtropics of the world. Formerly, leaving the monotypic New Caledonian genus *Stromatopteris*, all the other species were included in a single comprehensive genus *Gleichenia* which was subdivided into three subgenera *Dicranopteris*, *Eu-Gleichenia* and *Platyzoma*. Recently Copeland<sup>1</sup> and others have split the former genus *Gleichenia* into five well-defined groups of species each under a generic rank. In India only two members belonging to this family are represented which according to the latter nomenclature are *Hicriopteris glauca* (Thunb) Ching (= *Gleichenia glauca* Hook.) and *Dicranopteris linearis* (Burm.) Underwood [= *Gleichenia linearis* (Burm.) Clarke]. Both these species are common at Darjeeling. They have been cytologically investigated with the usual acetocarmine squash method to see if this generic distinction is cytologically justified.

*Hicriopteris glauca* is known to be a highly polymorphic species with a wide area of distribution from Malaya, Burma, India to Japan. In Darjeeling it grows abundantly in straggling stretches 20 feet or more long, forming huge thickets along roadside in open environments. The plants in this area represent a uniform population without any morphological variations. At metaphase, 56 bivalents are present in a

number of mother cells (Fig. 1). The chromosomes show 1-2 chiasmata and assume usual configurations of X's, Y's, O's and V's. Meiosis



FIG. 1. *Hicriopteris glauca*,  $n = 56$ ,  $\times 935$ .

FIG. 2. *Dicranopteris linearis*,  $n = 39$ ,  $\times 1,260$ .

is perfectly normal resulting in tetrads with well filled spores which number 512 per sporangium. It will be difficult to judge the basic number of this genus unless more species are investigated.

*Dicranopteris linearis* is also known to be a polymorphic species and Holttum<sup>2</sup> describes not less than six varieties from Malaya. In India the species is reported from various parts of Eastern Himalayas as far west as Kumaon and also from mountains of S. India and Ceylon.<sup>3</sup> At Darjeeling it is common, though by no means abundant, forming huge thickets scrambling on other plants along the fringes of the forests. Apparently the population in this area is uniform. Cytological investigation has shown 39 bivalents in a number of plants with perfectly normal meiosis resulting in 256-360 spores per sporangium (Fig. 2). This agrees with the observations of Manton and Sledge<sup>4</sup> who describe  $n=39$  for the var. *malayana*. Christ growing in Malaya. They also recorded a tetraploid form with  $n=78$  from Kandy, Ceylon, which probably represented a shade-loving type.

The diversity of chromosome numbers 56 and 39 with no correlation between them exhibited by *H. glauca* and *D. linearis* cytologically justifies their segregation under two different genera done in the modern taxonomic treatment.

Dept. of Botany,  
Panjab University,  
Amritsar, March 24, 1956.

P. N. MEHRA.  
GURDIP SINGH.

1. Copeland, E. B., *Genera Filicum*, 1947, Waltham, Mass., U.S.A.
2. Holttum, R. E., *Flora of Malaya*, II. *Ferns of Malaya*, 1954, Singapore.
3. Beddome, R. H., *Handbook to the Ferns of British India, Ceylon and Malay Peninsula*, 1883, Calcutta.
4. Manton, I. and Sledge, W. A., Observations on the Cytology and Taxonomy of Pteridophyte Flora of Ceylon," *Phil. Trans. Roy. Soc. London*, 1954, 238 B, 127.

## REVIEWS

### Statistical Methods for Agricultural Workers.

By V. G. Panse and P. V. Sukhatme. (Indian Council of Agricultural Research, New Delhi), 1956. Pp. xvi + 361. Price Rs. 15.

The volume under review has been written to meet the day-to-day needs of agricultural and biological workers and to serve as a suitable text for teaching the subject to the students of these two sciences. Part I with six chapters deals with useful statistical techniques and Part II with ten chapters deals with the design of experiments.

The authors try to fulfil their objective by limiting the scope of the book to the bare essentials, introducing formulæ without mathematical derivations and by using well chosen illustrative material in the discussion of statistical techniques. For instance, the authors consider multi-nominal distribution as beyond the scope of the book and content themselves by just mentioning its existence. The only formula proved (why?) is the partition of sum of squares in a two-way analysis of variance table. No formula seems to have escaped without being exhibited in its numerical aspects, an instructive technique one finds in the books of Sir Ronald A. Fisher.

Part II on the design of experiments is perhaps the more attractive, containing as it does very useful material particularly in the field of agriculture. The chapters towards the end of the book on groups of experiments and experiments on cultivator fields give a good introduction to problems of current research. Chapter VII on principles of field experimentation and Chapter XV on practical considerations contain useful tips to the practical workers. The rest of the chapters contain the description and analysis of designs which have been tried out in India. The authors could have been somewhat liberal in letting the readers know that there exists a greater variety of designs useful in plant breeding trials than what is treated in the book.

The appendices contain tables of significant values of  $t$ ,  $F$ ,  $\chi^2$  statistics, one, two and three digit random numbers.

The book seems to have been written with great care. However, a few mis-statements have crept in. For instance, the discussion of consistency on pages 85 and 94 is confusing. The interaction  $\chi^2$  on page 85 is interpreted

as testing an unprecisely stated hypothesis. The volume will no doubt serve a useful purpose.

C. R. RAO.

### Organic Insecticides—Their Chemistry and Mode of Action. By Robert L. Metcalf. (Interscience Pub.). Pp. x + 392. Price \$ 8.50.

Insecticides are as important as drugs for the well-being of humanity. If drugs are curative, insecticides play a preventive role. Further, they are essential for the conservation of foodstuffs, development of agriculture and animal husbandry. Though considerable attention was given earlier to the control of insects, it is only during the present century that insecticides have come into their proper place. Originally plant materials were employed, but the insecticides now in common use are largely synthetic. The most important advance was the discovery of insecticides of plant origin having selective action, that is, toxic to insects and non-toxic to human beings and domestic animals. This has been followed by the preparation of synthetic chemicals having considerable selective action. The secret of the great success has been sought in the molecular structure of the concerned compounds.

The book under review gives an up-to-date account of the chemistry and the mode of action of organic insecticides. The chemical part describes in brief the chemical properties and molecular structure. More detailed information is given on the relation of structure to toxicity, mode of action and mammalian toxicology. Coming from an experienced entomologist these topics are excellently dealt with and the treatment will be useful both to chemists and to biologists concerned with the subject of insecticides. The order of treatment of the insecticides is a natural one, starting with plant materials like nicotine and its allies, rotenoids and pyrethroids followed by the synthetic insecticides in the order of their discovery and introduction into common use. Among the fourteen chapters in the book, one chapter of 30 pages is devoted to synergism, another chapter to insecticide-resistance, providing critical accounts of the two important topics. The book should therefore be a great help in stimulating orderly development of this subject of insecticides.

T. R. SESHADRI.

**Isotopic Gas Analysis for Biochemists.** By R. F. Glascock. (Academic Press, Inc.), 1954. Pp. viii + 247. Price \$5.80.

The advantages of using isotopic tracers for the solution of biochemical problems have been fully realised and the use of labelled compounds is now becoming common practice. Unfortunately, the isotopes most useful for the biochemists are amongst the most difficult to assay. The correct choice of the technique of assay for the problem in hand, therefore, may well decide progress. The book under review will prove of great value in this respect since it discusses the various procedures for the analysis of the isotopes of carbon, hydrogen and nitrogen, and presents the significant aspects of current development in isotopic gas analysis in a satisfactory manner. Though not an exhaustive treatise, the material presented should give it a wide use among biochemists contemplating the use of isotopic tracers.

In the introductory chapter, the advantages of gas phase analysis over other methods have been emphasised and a comparative survey of  $C^{14}$  counting techniques has been given. In Chapter 2, one of the primary requisites of the gas phase analysis—the vacuum manifold—has been dealt with in great detail. The description is eminently practical and leaves very little to be desired. The next two chapters are mainly devoted to the various methods of gas counting of carbon-14. The most recent methods have been included; counting apparatus and the elementary physics of counting have also been briefly touched. An account of the preparation of active samples for counting, by wet and dry combustion, has been given in Chapters 5 and 6. The next three chapters confine themselves to the methods of assay for isotopes of hydrogen—namely deuterium and tritium; the author has briefly mentioned the use of mass spectrometry and Popjak's falling drop method amongst other modern methods.

In Chapter 11, the methods of synthesis of some specific labelled compounds with the isotopes of hydrogen are given. This gives an idea of the technique to be adopted in general for obtaining desired labelled compounds. One would perhaps miss such a chapter for the other isotopes. Preparation of heavy nitrogen samples for mass spectrometric analysis has been given in Chapter 10; details of mass spectrometry as such are omitted. The book concludes with a brief description of *in vitro* oxidation procedures.

The twelve chapters are fully documented and contain a total of 105 references. These

references with complete author and subject indexes enable one to easily find any topic discussed in the book. The style is pleasing, not too highly technical and easy to follow. The text is profusely illustrated with diagrams. The printing and the get-up of the book conform to the high standard of the Academic Press.

M. DAMODARAN.

**Glutathione.** (*Proceedings of the Symposium Held at Ridgefield, Connecticut, November 1953.*) Edited by S. Colowick, A. Lazarow, E. Racker, D. R. Schwarz, E. Stadtman, H. Waelsch. (Academic Press, New York), 1954. Pp. x + 341. Price \$7.50.

The biochemical and other functions of glutathione have assumed great importance in recent years with the discovery of the significant role of sulphhydryls ( $-SH$ ) in various metabolic reactions. The volume under review gives an account of the proceedings of the symposium held at Ridgefield, Connecticut, U.S.A., in November 1953, of the twenty-nine scientific papers which were read and of the discussions which followed after presentation of each paper. Eminent biochemists like Melvin Calvin, Theodor Wieland, J. A. Stekol, A. Lazarow, Z. Dische, J. S. Fruton, Konrad Bloch and others have presented papers and have also participated in the discussions. The editors have conveniently divided the papers under the following four divisions: (i) Properties and Organic Chemistry of Glutathione, (ii) Methods for Detection and Assay of Glutathione and Sulphydryl Compounds, (iii) Biochemical Mechanisms, and (iv) Physiological Actions and Clinical Aspects. The largest number of papers are under biochemical mechanisms and perhaps rightly so since extensive work has been done on this aspect in recent years. Among the topics discussed at length, under this division, particular mention may be made of the following: the biosynthesis and enzymic oxidation and reduction of glutathione, glutathione as a co-enzyme, the importance of glutathione in transpeptidation and the role of sulphhydryl compounds in acyl transfer. Under methods, a review of chemical methods is presented as also an account of paper chromatography of glutathione and its hydrolysis products and the histochemical methods on sulphhydryls and disulfides. The last section on physiological actions and clinical aspects deals with such topics as relation of glutathione to hormone action and diabetes as well as glutathione in radiation injury and in human disease. It must

be admitted, however, that the mechanism of action of glutathione in most of these clinical conditions is as yet unknown.

The volume under review can be considered to be of great value in that it will greatly help research progress by "emphasizing those scientific areas where more knowledge is urgently needed as well as by pointing out others in which further research does not appear profitable". The get-up of the book is excellent and Academic Press deserves praise for bringing out such a timely publication on an important subject in biochemistry.

P. S. SARMA.

---

**The Diamond Tool Industry in 1955.** (Issued by Industrial Diamond Information Bureau, 32/34, Holborn Viaduct, London, E.C.1.) Pp. 12. Free of charge.

As in previous years, the Industrial Diamond Information Bureau has compiled a survey of the diamond tool industry, dealing with various scientific and technical aspects. Whilst no entirely new developments could be traced, practically all branches of the industry made important advances during the past year. The subject-matter, mainly based on the Bibliography of Industrial Diamond Applications, is subdivided into 16 main groups; about 200 references are quoted. The literature mentioned can be made available to enquirers.

---

**The Chemical Industry in Europe.** (Published by the O.E.E.C., 2, rue Andre, Pascal, Paris 16<sup>e</sup>.)

This excellent study constitutes the 'Second Annual Report drawn up by the Chemical Products Committee of the OEEC'. (The first report was published in autumn 1954.) Part I of the report discusses in detail the various factors of supply and demand which affect the progress of the chemical industry. In Part II the chapters on various sectors are in general arranged as per the Standard International Trade Classification for Petroleum Chemicals. The range of the report is restricted to those sectors or groups of products for which information was available.

It is observed that the total value of the O.E.E.C. countries' chemical industry is estimated at \$ 5,000 to 6,000 million in 1954 as compared to \$9,000 million in 1954 for United States. Production of chemical industry in O.E.E.C. countries rose on an average by 15% over 1953. The expected expansion of the world nitrogen industry in the next few years causes apprehension as to the possibility of

disposing of the quantity produced, and probably these countries will have to export the nitrogenous fertilisers to underdeveloped countries. One of the main concerns of the chemical industry in Europe is the recruitment of technical staff. With the rapid expansion of the chemical industry, demand for basic chemicals rose considerably in 1954, as home supplies of organic chemicals and crude chemicals from coal, petroleum, natural gas have been inadequate to meet the increased demand and the member-countries have had to import these from U.S.A. In Part II of the report data regarding production, imports and exports, and general trends of development of industry have been given for basic chemicals, petroleum chemicals, dye-stuffs, tanning materials, paints and related materials, soaps and detergents, fertilisers, plastic materials and miscellaneous chemical products. A study on sulphurous raw materials' position in 1954 is also annexed to the report. Such compiled data will be of immense use to all of those engaged in the chemical industry.

G. S. LADDHA.

---

**Animal Nutrition.** By E. J. Sheehy. (Macmillan & Co.), 1954. Pp. 731. Price 30 sh.

In this practical book, the author shows how scientific discoveries can increase the efficiency of production by economic and proper feeding of the farm animals. Though primarily written for the Irish farm conditions, it has worldwide applications in putting to practice the newer knowledge described here. Among the many important topics dealt in the 17 chapters are 'Quantitative Metabolism', 'The Farm Animal, Economy, Functions and Products', 'Mineral and Vitamin Deficiencies' and 'Antibiotics'. The first part of the book discusses animal physiology and fundamental nutrition. The second part deals with foods and food consumption. The third part is concerned with the economic production of milk, eggs and meat.

Professor Sheehy expresses in simple language and illustrates "how science leads to good practice in livestock husbandry and good practice leads to profitability". The nutrition of the modern dairy cow and the productivity of the laying fowl demand specialist feeding and management. Food alone constitutes on the average more than 60% of the cost of milk production and the economy of milk production depends on the cost of the food. Because of underfeeding the genetical capability of very many dairy cows is not being fully expressed. The cow with a long life-history



in the milking herd is a more economical animal than a similar one whose milking life is shorter. The author's own experiences with feeding of antibiotics are also mentioned as well as other newer results concerning animal feeding. He has succeeded in bridging the gap between scientific discovery in animal nutrition and its application in practice. This book will be of great interest and use to the students as well as livestock farmers who are striving hard to correct the world shortage of protective foods of animal origin.

V. R. RAJAGOPALAN.

#### Rothamsted Experimental Station Report for 1954.

The 1954 report of the Rothamsted Experimental Station records yet another year's successful progress in the various sections. Several lines of fundamental research are being carried on at the Station and may be expected to prove useful in applied science. It is, of course, very difficult, to do full justice to all aspects of the excellent work enumerated in the report and only the more salient points can be touched on.

For successful and efficient farming a good soil structure is a prerequisite. A new 'sodium saturation method' successfully applied for the determination of the crumb structure would enable the quantitative expression of soil structure. Further progress has been made in the physics department in the development of techniques for estimation of potash and phosphate status of soils. On the micro-meteorological side, interesting experiments on dew formation on grasses and potato have shown that dew is insignificant as a water source for the potato crop. In the chemistry department, besides continuing field experiments on horticultural crops, significant advances have been recorded in radio-tracer work on the uptake of phosphorus by cereal plants.

Further research on the nature of inhibition of root disease fungi by actinomycetes has brought out evidence to show that it is an antibiotic action and not a mere competition between the fungi and the antagonist for essential treatment. This is an important finding of interest to pathologists.

Experiments on the factors controlling the uptake of ions by excised roots have shown that the rate of potassium intake increased with higher concentration of fructose content but decreased with higher concentrations of glucose or sucrose. These observations will greatly

aid in the proper understanding of the factors concerned in ion intake by roots.

The dependence of the oxidation velocity at physiological concentrations of  $Mn^{++}$  on the intensity of illumination and the amount of chlorophyll present in the chloroplast preparations has been indicated in the experiments conducted in the biochemistry department. This suggests that a  $Mn^{++}$  oxidation-reduction cycle may be involved in the reactions of photosynthesis.

The fascinating line of work of tissue culture as a method for obtaining virus-free plants from infected stalks is being carried out in the plant pathology department. Success along this line will enable the production of virus-free plants by culturing the excised stem meristems from infected plants. Progress has been made in the study of virus diseases affecting crops like potato, sugar beet, etc.

Paralysis due to  $CO_2$  poisoning and the subsequent conditioning to such poisoning has been one of the very interesting observations reported by the insecticides and fungicides department. This finding will no doubt help to improve the laboratory technique for the assay of insecticides and fumigants.

Soil science and the Rothamsted Station have suffered a grievous loss in the death of Dr. E. M. Crowther during 1954. This classified list of publications by Dr. Crowther appended to the report brings together the activities of a person who dedicated his life for the advancement of soil science.

As the previous reports, this report should also prove of interesting and informative reading to all physico-chemical and biological scientists. The get-up of the report conforms to the usual high standard and perfection.

N. L. DUTT.

#### Books Received

*Physics of Fully Ionized Gases.* By Lyman Spitzer, Jr. (Interscience), 1956. Pp. ix + 105. Price \$ 1.75.

*The Chemistry and Reactivity of Collagen.* By K. H. Gustavson. (Academic Press), 1956. Pp. ix + 342. Price \$ 8.00.

*Germanium Diodes.* By S. D. Boon. (Philips Technical Library), 1956. Pp. viii + 85. Price not given.

*Progress in Nuclear Energy, Series I. (Physics and Mathematics), Vol. I.* Edited by R. A. Charpie, S. T. Horowitz, D. J. Hughes and D. J. Littler. (Pergamon Press), 1956. Pp. x + 398. Price 70 sh.

---

## SCIENCE NOTES AND NEWS

---

### Elimination of Static Electricity by Radioactive Substances

A method of eliminating static electricity by means of radioactive preparations has been elaborated by the safety techniques department of the Moscow Institute of Chemical Machine-Building. Radioactive polonium-210 which emanates alpha particles, is used for this purpose. A metal plate with a thin coating of polonium-210 is hung in the area of charge formation; this ionises the air and neutralises the static electricity. The danger of injury, fire and explosion from static electricity is thus eliminated.

### Measurements of Deep Ocean Currents

For the first time, direct and reliable measurements of the currents in the deep ocean basins have been made free from the uncertainties involved in using a conventional current meter from an anchored ship. Dr. J. C. Swallow, of the National Institute of Oceanography, has developed a technique whereby a neutrally buoyant float can be followed for several days by listening to the acoustic signals that it transmits. The density of the float, which consists principally of two 10' aluminium scaffold tubes sealed at the ends, is carefully adjusted to be greater than that of water at the surface of the sea and less than that of the bottom water, so that it floats at a predetermined depth in midwater.

### New Metals for Nuclear and Jet Power

Air speeds of the order of Mach 3 and 4 are now considered to be round the corner, and speeds of the order of Mach 15 are considered to be the next horizon. Such speeds cannot be attained with normal fuels, and research is now proceeding to develop the use of metallic fuels, and boron compounds such as one of the boron hydrides may well produce the power necessary to push machines through whichever barrier may be between them and Mach 15. Among less spectacular and speculative metals it is possible to name several which will almost certainly play a part in the future progress of nuclear or jet power. Beryllium, zirconium, tantalum, niobium, and molybdenum would be included in such a list.

### Atomic Energy Board in USSR

A Central Atomic Energy Board under the USSR Council of Ministers has been organized to promote broad application of atomic energy in all branches of the national economy of the USSR and co-operation of the Soviet Union with other countries in the peaceful uses of atomic energy. The Central Board is charged with developing atomic reactors for power stations and other power installations and guiding research in exploring other ways of using atomic energy. Prof. Efim Slavsky has been appointed Chief of the Central Atomic Energy Board.

### Regional Research Laboratory, Hyderabad

The Central Laboratories for Scientific and Industrial Research, so far working under the Government of Hyderabad State, were formally taken over by the Council of Scientific and Industrial Research, Government of India, as from April 1, 1956. Under its new name of Regional Research Laboratory, Hyderabad, it now becomes the first regional laboratory of the Council of Scientific and Industrial Research, retaining its characteristic features and basic research programmes. Dr. S. Husain Zaheer remains as Director and the research staff continue as before. This step now assures the full development originally planned for this laboratory.

### International Congress on Cybernetics

An International Congress on Cybernetics is to be held in Namur, Belgium, from June 26 to 29, 1956, under the sponsorship of the Belgian Ministry of Education and UNESCO. The work of the Congress will be divided into four sections. The first, under the Chairmanship of Professor Pierre Auger, Director of UNESCO's Department of Natural Sciences, will consider principles and methods of cybernetics, including information theory, learning, operational research, theory of games, etc. The second, on semantic machines, which deals with computing and translating machines, multi-purpose logical machines and many others, will have for its Chairman, Dr. Louis Couffignal, Director of the Automatic Computation Laboratory in Paris.

The third section, concerned with the latest developments in automation, will be under the Chairmanship of Professor Georges R. Boulanger of Brussels University who is President of the Congress. Fourthly, a group presided over by Dr. W. Grey Walter, of the Burden Neurological Institute in the United Kingdom, will discuss the impact of cybernetics on biology, physiology, medicine, psychology, social sciences, etc.

#### Value to Dairymen of Radioactive Materials

According to Dr. C. W. Turner, of the Dairy Department of the University of Missouri, the use of radioactive iodine to determine thyroxine secretion rate in cattle may be valuable to dairymen when selecting breeding stock; for, all hormones involved in lactation need to be secreted at optimum levels for maximum and continued high levels of milk production. Therefore, ways to measure hormone secretion rate are needed so that breeders of dairy cattle may locate the cause of low milk production.

Dr. Turner sees current and future studies of endocrine gland secretion as helpful in two ways. One is long range—the making of measurements that will be helpful to breeding better stock. The other is immediate—use of methods to supplement the animal's own secretion of these hormones where it is less than optimum.

Work at the Missouri station has already shed considerable light on methods of supplementing deficiencies. Dr. Turner and co-workers have developed iodinated casein for feeding to dairy cows with sluggish thyroid glands. This material can be used to stimulate milk production after the cows have passed their peak in natural production.

#### Traces of Aureomycin for Food Preservation

A new method of food preservation was recently demonstrated at the National College of Food Technology, Smithfield, England. Dr. John H. Taylor, who is co-ordinating research on the subject, observes that the addition of a minute amount of antibiotic aureomycin to perishable foodstuffs maintains the freshness by retarding the growth of spoilage bacteria which otherwise cause rapid deterioration. The method, called 'acronizing', has been acclaimed as the greatest advance in the field of processing perishable foods since the advent of refrigeration some 25 years ago. Only "trace" amounts

of aureomycin are required and research has shown that it all disappeared after cooking. None of the antibiotic was actually consumed.

#### FAO Fisheries Officer for Asia and the Far East

Mr. Colin Beever, Fisheries Economist from the Headquarters of the Food and Agricultural Organization, Rome, has been appointed Acting Regional Fisheries Officer for Asia and the Far East. Mr. Beever has represented Fisheries Division, FAO, at various meetings, and was Associate Director of the Training Centre for Fishery Administrators which was held in Copenhagen, Denmark, in September and October last year.

#### Colonel Amir Chand Trust Prizes for Medical Research

It has been decided to award during 1956 six prizes of the value of Rs. 300 each for the best published research work in any subject pertaining to all fields of medical sciences including clinical research, during the year 1955. The award of the prizes will be announced by the Indian Council of Medical Research, during November/December 1956.

The candidates are required to submit 10 reprints of their papers published during 1955. These should be sent to the Director, Indian Council of Medical Research, P. Block, Raisina Road, P.O. Box 494, New Delhi, so as to reach him not later than the 1st August 1956. The papers should be accompanied by a short biographical sketch and two copies of passport size photographs of the worker or workers concerned.

#### Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Pharmacy to Sri. B. V. Rama Sastry for his thesis entitled "Investigations on Leguminous Plant Insecticides and Fish Poisons".

The University of Poona has awarded the Ph.D. Degree in Botany to Shri M. S. Chennaveeraiah for his thesis entitled "Cytoembryological Studies on *Dipcadi medic.* (Fam. Liliaceae) and *Hyphaene* (Gaertn. (Fam. Palmae), with a note on the Karyotypes in the *Marsileaceae*"; and to Shri B. Biswas for his thesis entitled "Ferns of Bombay State: The Structure and Life-History of *Anisogonium esculentum* Presl. and Some *Acrostichoid* Ferns".

# Current Science

Vol. XXV]

JUNE 1956

[No. 6

	PAGE		PAGE
<i>Progress of Fisheries Development in India</i> .. .. .	175	<i>Lady Tata Memorial Trust Scholarships and Grants for the Year 1956-57</i> ..	181
<i>Choice between Atomic and Astronomical Standards of Time</i> .. .. .	177	<i>Utilization of South Arcot Lignite Char as Domestic Fuel—C. V. S. RATNAM AND V. S. RAMANATHAN</i> .. .. .	182
<i>The International Atomic Energy Agency</i>	178	<i>Bhilai Steel Project</i> .. .. .	183
<i>Water Requirement of Irrigated Wheat—Variety Kenphad—S. VENKATARAMAN</i> ..	179	<i>Letters to the Editor</i> .. .. .	184
<i>Utilization of Wind Power in India</i> ..	180	<i>Reviews</i> .. .. .	203
<i>Studies on Radiation Problems</i> .. .. .	181	<i>Science Notes and News</i> .. .. .	207

## PROGRESS OF FISHERIES DEVELOPMENT IN INDIA

AS observed by Sri. A. P. Jain, Minister for Food and Agriculture, Government of India, in his message to the All-India Fisheries Exhibition\* organised recently in Cuttack, the development of fisheries is a problem of national importance, but unfortunately in the past fishery has not received the attention that it deserves. Since the planning began, more attention has been devoted to this important aspect of food problem and under the Second Plan, considerable provision is expected to be made for the development of fisheries and fishing craft on an organised and scientific basis.

The Union and the State Governments have been taking progressive measures for increasing fish production and developing the fishing industry in India, with a noticeable measure of success. With financial and technical assistance from the Centre, most of the States have been able to substantially increase their production by bringing under fish culture large

areas of inland waters and by extending and intensifying fishing operations in coastal waters.

The Central Marine Fisheries Research Station was established in 1947 to carry on research on problems of marine fisheries with a view to estimating the resources, the rate of present exploitation, the possibilities of increasing production and utilization and recommending measures of conservation, if necessary. The Station was originally started at Madras, but is now located at Mandapam in South India. The work of the Station is done at headquarters and at a number of Substations. The Substation at Bombay specialises in research on offshore fisheries, that at Karwar on mackerel fisheries, that at Calicut on fishery biology and on the oil sardine and mackerel fisheries, that at Cochin on prawn fisheries and that at Madras on molluscan fisheries. Biological and statistical data relating to fish landings are collected by trained survey assistants stationed in twelve different zones of the coast and are analysed at the headquarters. Studies on marine biology; hydrology, utilization of sea-weeds, marine fish farming and on certain small fisheries are also carried on at Mandapam. The Station is under

\* A Souvenir Volume published on the occasion contains authoritative articles by specialists on various aspects of fisheries research and development in India.

the charge of a Chief Research Officer, who has a team of trained zoologists, botanists, chemists, bacteriologists and others to assist him.

Under the Second Five-Year Plan the Station will expand its activities relating to the studies on principal commercial fisheries (mackerel, sardines and prawns), offshore fisheries, marine biology with increased emphasis on its relation to pelagic fisheries, and effects of various kinds of fishing on fish stocks. Additional research substations will be established.

The Central Inland Fisheries Research Station was also established in 1947 and started its life at Calcutta. It was later shifted to Barrackpore, but, on account of some damage to its buildings there, has been temporarily brought back to Calcutta. The work of the Station is broadly divided into three main sections, *viz.*, Estuarine, Pond Culture and Riverine and Lacustrine. The work of the Estuarine Section and that of training, along with certain other activities, is carried on at the headquarters, while that of the Pond Culture and the Riverine and Lacustrine Sections is done at the Substations at Cuttack and Allahabad respectively. This Station also is under the charge of a Chief Research Officer, who is assisted by a band of workers especially trained in different branches of fisheries research.

Under the Second Five-Year Plan it is proposed to intensify the existing programme of investigations with particular reference to estuarine fisheries, brackish water fish farming, fisheries in natural and artificial lakes, fisheries in the large river systems, fish cultural practices, effect of river pollutions on fisheries, and the control of weeds. Additional Substations are also expected to be established.

The Pilot Deep-Sea Fishing Station was established in 1947 at Bombay and an ice and cold storage plant was put up in 1951. The vessels of the Station have completed the charting of fishing grounds off the coasts of Bombay and Saurashtra up to 40 fathom line in addition to exploratory fishing and providing training in various powered-fishing methods. The ice and cold storage plant provides the much-needed facilities for icing, storage and freezing of fish catches, and very useful technological work in this connection is also being conducted. It is proposed to further extend the activities of the Station and undertake charting of fishing grounds beyond the 40 fathom line. Exploratory fishing and charting of fishing grounds will also be undertaken further south on the West Coast and also on the East Coast in the Bay of Bengal with different types of fishing vessels. For this purpose,

exploratory fishing stations will be established at Cochin, Visakhapatnam and Port Blair. Additional facilities for cold storage and transport of fish catches and utilisation of fish waste will also be provided.

A Fisheries Technological Station will be established to undertake investigations on designs of fishing nets and other gear likely to prove suitable in our waters; materials for the manufacture and preservation of nets and gear; storage of fish in fresh, chilled and frozen condition; processing and utilisation of fish and other marine products; and for establishing commodity standards and grades for marketing and inspection, etc.

One of the principal difficulties in implementing plans for fisheries development, on a more extensive scale and at a faster rate than at present, is the lack of adequate trained personnel. The need for the training of staff in the management and development of fisheries in States was realised several years ago and training centres for the purpose were started at the Central Marine and Inland Fisheries Research Station in 1948.

The centre at Madras was later discontinued, but is proposed to be revived at Mandapam. The ten months' training course is mostly utilised by officers deputed by State Governments, but a few private candidates are also admitted. Facilities for a short-term refresher course on fisheries research are also available at the Central Research Stations. Training in powered fishing operations is provided on the vessels of the Central Deep-Sea Fishing Station and eight fishermen are, at present, undergoing a four-year training course. Short-term training of 3-4 months was also provided to 23 State Fishery Officers on the Japanese vessel, *Taiyo Maru No. 17*. In addition, the West Bengal Government are providing training facilities on board their trawlers.

The Central Government is assisting in providing training in fishing from small mechanised boats and maintenance of engines at Satpati under a joint scheme of Saurashtra and Bombay States. Madras and Travancore-Cochin States will also shortly set up joint training centres at Cochin and Tuticorin with Central assistance. Similar training is being provided by the Norwegian Community Project in Travancore-Cochin. It is expected to train 800 fishermen at these centres. It is proposed to establish additional training centres during the Second Five-Year Plan and also increase training facilities in powered fishing when more fishing vessels and expert technicians become available.

## CHOICE BETWEEN ATOMIC AND ASTRONOMICAL STANDARDS OF TIME

ESSEN AND PARRY<sup>1</sup> described a year ago a frequency standard based on a natural resonant frequency of the caesium atom, which has been used for calibrating the quartz clock standards with an accuracy of 1 in  $10^9$  (0.0001 sec. per day). The atomic beam magnetic resonance technique first developed by Rabi and collaborators and used by these authors holds out a prospect of even higher accuracies.

Commenting on this, Sir Edward Bullard<sup>2</sup> has solicited views on the desirability of abandoning the astronomical second for the most refined measurements in view of the high precision of atomic frequency standards now available. His argument runs as follows:

Ephemeris Time, on which the definition of the second adopted by the International Astronomical Union and the International Committee of Weights and Measures depends, is derived from the motion of the Moon. If the position of the Moon at any time can be determined to 0.05 sec., a period of four years would be necessary to obtain an accuracy of 1 in  $10^9$  in time and frequency derived from astronomical observation. Essen and Parry mention Markowitz's proposals for reducing this period to one year; these depend on a reduction of the errors by repetition of observations. Such a reduction would involve a study of systematic errors in star places and in the corrections for differential refraction that would certainly take many years. During this time atomic clocks will be improved, probably by a greater factor than the astronomical determinations.

It thus seems probable that for the foreseeable future the accuracy of the measurement of frequency and of time intervals relative to laboratory standards will exceed that by astronomical means, and that the astronomically defined second is therefore incapable of realization with the accuracy necessary for microwave spectroscopy. The natural way of escape from this difficulty is to define a 'physical second' in terms of the natural period of the caesium atom, choosing the numerical value so that it agrees as well as may be with the current estimate of the second of Ephemeris Time.

In regard to the above, Clemence<sup>3</sup> directs attention to two consequences that should be well understood before the astronomical second is abandoned by physicists.

The first is, that by using the atom at once as a standard of length and of frequency the

units of length and of time lose their independence; wave-lengths and frequencies have a fixed relation to each other, the product of the two being the velocity of light. Hence it is of the utmost importance that the new units should not be exclusively employed; atomic wave-lengths must be compared with the metre from time to time, and atomic frequencies must be compared with the astronomical second. To fail to do so would be unnecessarily to restrict the science of physics at its very foundations, by assuming what can only be verified by experiment.

The other arises from the fact that an atom, while it undoubtedly gives an excellent natural standard of frequency, is not a natural clock. It is probable that two caesium standards built to the same specifications on opposite sides of the Atlantic would run at the same frequency; but if each were made to control the hands of a clock through a suitable mechanism, the two clocks would *not* indicate the same time (epoch). Even if they could be brought to the same time with enough precision to satisfy astronomers and geodesists—which is doubtful—if both should stop it would be impossible on starting them again to determine how much time had been lost. For actual time-keeping it will be necessary, as in the past, to rely on better mechanisms than man-made ones. The consequence, then, of adopting the new 'physical second' would be to use one second for measurements of frequency and another for actual time-keeping.

Regarding the reduction of the errors of astronomical observations by repetition, he observes that the systematic errors in star places and the differential refraction are not important limitations when periods of a year or more are considered. He estimates that with four dual-rate cameras observing the Moon, an accuracy of 1 in  $10^9$  in time and frequency derived from astronomical observations can be attained in a year, and probably 1 in  $10^{10}$  in five years. But it would appear that Bullard's argument is not affected by these estimates. He suggests therefore that before specifying the new unit of time, physicists might wait for the end of the International Geophysical Year, by which time a good number of observations of the Moon will have been made, and to compare atomic standards with astronomical ones assiduously in the meantime.

This question has also been discussed at length by Abraham<sup>4</sup> more recently. He observes that the essential requirements for the fundamental unit of time are that it must be the same whenever and wherever it is needed and that it must be susceptible of exact measurement. (The actually observed quantity need not be constant provided its relationship to the fundamental unit is known.) There can, moreover, be only one fundamental standard, and this should be the standard of Ephemeris Time. This standard should be retained be-

cause its stability and permanence are independent of its users, and also because it can be measured with sufficient accuracy for the purpose. In his opinion atomic clocks are to be recommended only as the precise and accessible sub-standards.

- 
1. Essen and Parry, J. V. L., *Nature*, 1955, **176**, 280.
  2. Bullard, E. C., *Ibid.*, 1955, **176**, 282.
  3. Clemence, G. M., *Ibid.*, 1955, **176**, 1230.
  4. Abraham, H. J. M., *Austr. J. Sci.*, 1956, **18**, 103.

### THE INTERNATIONAL ATOMIC ENERGY AGENCY

**A**N international agency for the development of the peaceful uses of atomic energy is to be established early in 1957, subject to the ratification of the statute by a special assembly of the UN to be held in September.

The agency will encourage and assist research, development and the practical application of atomic energy for peaceful uses throughout the world and will foster the exchange of scientific and technical information as well as the exchange of scientists and of experts among nations. Its chief purpose would be to act as a "bank" to receive, store and issue uranium fuels and other atomic materials and thus to make them available to the industries of the world beyond the borders of the few countries that can produce these materials.

Under the present draft of the statute, the agency could accept the 440 lb. of uranium-235 which the United States proposed in 1954 to contribute for international purposes, the 44 lb. allocated by the United Kingdom, and the unspecified amount that the Soviet Union has offered. None of these offers have, of course, been made to the agency as such, since it is not yet in existence. But the total would represent a large capital endowment. The U.S. Atomic Energy Commission has set a price of \$25 a gram on uranium-235, so that the amount proffered, 200,000 grams, would be worth five million dollars.

Even broader is another function of the agency. It will make provision for materials, services, equipment and facilities to meet the needs of research and the practical application of atomic energy for peaceful uses, including

the production of electric power, with due consideration for the needs of the underdeveloped areas of the world. This seems to envisage a large function of leadership in atomic development. The agency is also authorized to acquire or establish any facilities, plant and equipment useful in carrying out its authorized functions, whenever the available facilities in the area concerned are inadequate or unavailable on satisfactory terms.

Since the fissionable materials could be diverted to military purposes and since their use in atomic reactors involves the production of materials that emit radiations, the Agency will also establish and operate a complete system of safeguards, both to prevent misuse of materials, equipment or information and to assure the protection of health, life and property from possible hazards. This includes the establishment of a staff of inspectors who will be responsible for the maintenance of safeguards and protective measures, not only by the Agency itself but by member States engaged on projects under agreement with the Agency.

There is no specific provision in the draft of the statute for any study or action by the Agency with regard to the training of atomic specialists or the introduction of educational improvements that the atomic age will demand in many countries. Neither is there any consideration of the vast economic and social consequences in industry, agriculture, medicine and society. Many of these fall within the scope of present organs of the United Nations and may therefore be left to the latter or undertaken co-operatively.—UNESCO.

# WATER REQUIREMENT OF IRRIGATED WHEAT—VARIETY KENPHAD

S. VENKATARAMAN

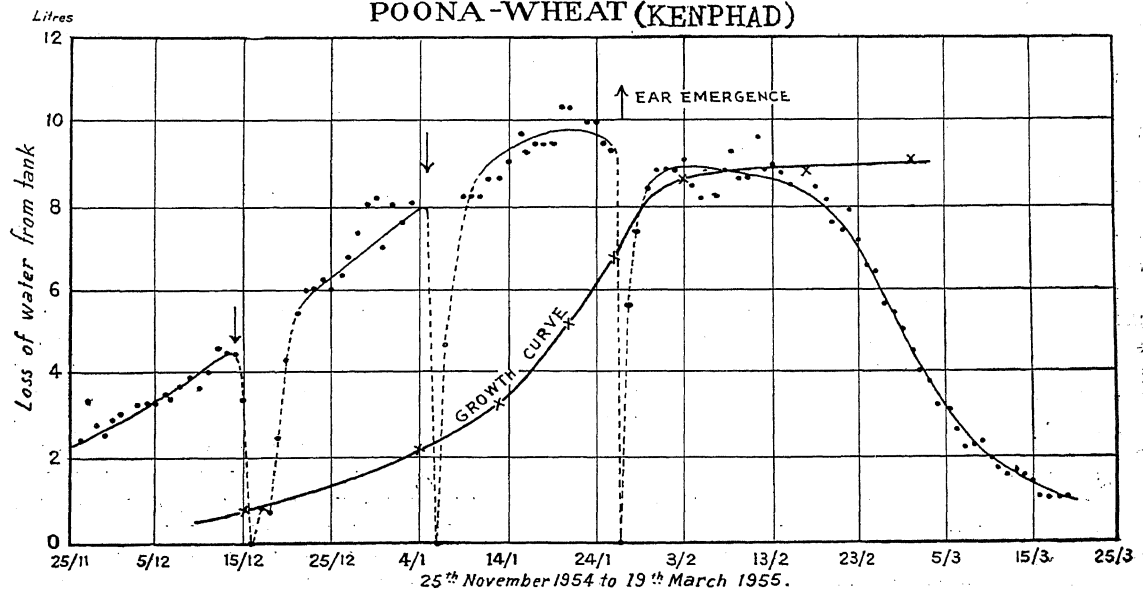
Central Agricultural Meteorological Observatory, Poona

**S**TUDIES on the water requirements of crops are engaging the active attention of the workers at the Central Agricultural Meteorological Observatory, Poona, under the auspices of a scheme sanctioned by the Indian Council of Agricultural Research. The design of suitable experimental techniques for assessing the water lost by evapo-transpiration is now in progress. The present note is concerned with the results of a preliminary experiment conducted during November 1954 to March 1955, on the wheat crop. The experimental arrangements tried out, functioning somewhat similarly to those of Thornthwaite<sup>1</sup> are described briefly below:

A galvanised iron tank  $5' \times 5' \times 2\frac{1}{2}'$  was buried in the field with 3" of its rim projecting over the surface of the soil. The tank was connected by means of an underground G.I. pipe line to a float mechanism, which in turn was connected to a supply reservoir through a needle valve so that a water-table could be maintained in the tank at a depth of 18" from the soil surface. The float mechanism had also an overflow arrangement to remove any excess water that tended to raise the water-table. Three such tank units were used and

the tanks were filled with soil so that the level of soil in the tanks and the field were the same. The tanks and field were planted with winter wheat crop. When the plants were one-week-old, each tank was irrigated from the top with an excess of water sufficient to cause an overflow and the overflow was collected and removed. As water was lost by evapo-transpiration, water from each supply reservoir moved into the respective field tank and daily readings of this loss was made. After 3 weeks' time, when the field was also being irrigated, each tank was irrigated with a known quantity of water sufficient to cause an overflow and the overflow was collected and measured. Any rain and the overflow from such rain during the interval between the two top irrigations were also recorded. The water requirement was given by the amount of water added to tank as top irrigation and any rain *plus* the amount of water lost from the supply reservoir *minus* the amount collected as overflow. Water requirement was estimated for 3-week intervals till the period of ear-emergence. Afterwards top irrigation was given only at the time of harvest to find out the water requirement for the period between ear-emergence and harvest. The

## EVAPO-TRANSPIRATION EXPERIMENT POONA-WHEAT (KENPHAD)





water requirement is expressed in terms of acre inches. The results are presented in Table I.

TABLE I

Wheat sown on 13-11-1954; germination complete on 18-11-1954; crop harvested on 19-3-1954. The average yield from tanks was 860 lb./acre.

Period	Consumption of water*
II to IV week	.. 1.7"
V to VII week	.. 2.8"
VIII to X week	.. 3.54"
XI week to harvest	.. 6.80"
Total	14.48"

\* Total for the period, average of three tanks.

It can be seen from Table I that the total water need of a wheat crop irrigated at intervals only but otherwise drawing moisture from a water-table 18" below the soil surface is of the order of 15" during the entire growing season.

Fig. 1 gives the average daily loss of water from the supply reservoir. In this is also given the growth of wheat crop in the tanks. It will be seen from Fig. 1 that the loss of water from the supply reservoir is reduced when water is added to the tanks from above but it attains a steady state in about a week. The daily loss of water from the supply reservoir is about 3 litres in the beginning of December and increases uniformly to about 9.5 litres by middle of January, i.e., about a week before ear-emergence (1 litre = 0.43 mm. of water). The period of maximum loss from tank corresponds with the period of maximum rate of elongation of the crop. The loss of water decreases after ear-emergence and particularly so after about 2 weeks.

These studies are being continued. The author is indebted to Dr. L. A. Ramdas and Shri S. P. Venkiteshwaran for their guidance in conducting this investigation.

1. Thornthwaite, C. W., "Report of the Committee on Transpiration and Evaporation," *Trans. Amer. Geophysical Union*, 1946, 27.

## UTILIZATION OF WIND POWER IN INDIA

INDIA has considerable resources of wind energy which have not been utilized to any large extent so far. With a view to developing these resources, the Council of Scientific and Industrial Research set up a Wind Power Sub-Committee in December 1952 with Dr. P. Nilakantan as Convener. The Committee was charged with preliminary investigations on the available wind power in the country which could be put to practical use, and study of various important aspects of the economic utilization of wind energy.

The Wind Power Sub-Committee started work by studying in detail the available meteorological data on surface winds, a large amount of which have been collected and analysed by the India Meteorological Department. These have proved very useful in giving general indications of wind regimes. From anemograph records, velocity duration and power-duration curves have been prepared. On the basis of the velocity-power duration diagrams, it has now been possible to establish a correlation between the annual mean hourly wind velocity and the availability of power for specified speed ranges for various regions.

As the wind velocities recorded at meteorological observatories are generally lower than those prevailing in the most favourable sites in the region, the Wind Power Sub-Committee

is now engaged in a programme of making more detailed surveys in order that a proper assessment of the availability of power under optimum conditions at favourable sites may be made.

The question of utilizing wind power for pumping water has been examined in some detail. As a result of preliminary surveys, the conclusion has been drawn that there are large untapped resources of wind power which could profitably be used in rural areas for such purposes as pumping water for drinking, sanitation, irrigation of small holdings, drainage, etc. Other possible uses of windmills in rural areas are for the processing of agricultural products, such as grinding corn, threshing and oil extraction.

Most regions in India have average wind velocities of less than 10 m.p.h. (16 km./hr.). Studies of windmill efficiency have indicated that economic utilization of windmills will be possible in these regions only by constructing fairly large size windmills at low cost using indigenous materials. A design project has been initiated by the Committee and a prototype windmill using wood and bamboo to a large extent has been developed and will be tested shortly. Several prototypes will be built and tested.

With regard to electricity generation through wind power the field in India is more restricted although regions in Saurashtra and Coimbatore are promising. A 6 to 8 KW wind-electric plant of German make is being obtained for experimental purposes. Large-scale use of such plants will be possible only after determining the most effective way of operating them with either batteries or auxiliary power systems.

A proposal is now under consideration by the Government of India for utilization of wind power on a large scale in accordance with a phased programme. It is contemplated to use more than 20,000 small windmills in rural areas and perhaps a few hundred medium-

sized wind electric plants for electric supply, for the operation of pumping installations and for supply of electricity in out-of-the-way localities for light-houses, plantations, etc.

The Wind Power Sub-Committee is now organizing the setting up of 20 wind survey stations in various regions in the country and expects to operate a few more pilot installations including the low cost type developed by the Committee and the 6 to 8 KW wind electric plant.

In all work relating to wind velocity surveys, the Wind Power Sub-Committee is being assisted by the India Meteorological Department.

---

### STUDIES ON RADIATION PROBLEMS

THE radiation dangers involved in working in atomic plants, or in laboratories and other institutions where radio-isotopes are used, were discussed at a recent meeting of scientists and medical men called by the World Health Organization in Geneva. The group recommended that standards laid down by the International Commission on Radiological Units should be used as widely as possible and that radio-isotopes should be handled only by technically qualified persons.

A second problem examined was that of training personnel in methods of protection. Besides the training of "health physicists" specializing in radiological protection, the experts recommended a more general instruction for other professional groups such as sanitary

engineers, public health administrators, ecologists and reactor engineers. The need for doctors trained in the medical use of radio-activity and in radiation protection was particularly stressed. The group recommended that instruction in these subjects be included in the curricula of medical schools.

Lastly it was emphasized that radiation hazards were likely to become a public health problem for entire continents. The possible pollution of rivers crossing several countries was particularly mentioned in this connection. It was urged that WHO should encourage the creation by competent bodies of international disposal areas where highly radioactive materials could be safely put away.—UNESCO.

---

### LADY TATA MEMORIAL TRUST SCHOLARSHIPS AND GRANTS FOR THE YEAR 1956-57

THE Trustees of the Lady Tata Memorial Trust have announced the following awards of Scholarships and grants for the year 1956-57.

The International awards of varying amounts (totalling £ 6,962) for research in diseases of the blood with special reference to Leucaemias are made to Doctors J. F. Kieler (Denmark), J. Ringsted (Denmark), J. Rygaard (Denmark), J. Nordmann (France), M. Seligmann (France), Professor H. Teir (Finland), Doctors C. G. V. Wasastjerna (Finland), G. Marinone (Italy), M. Simensen (Copenhagen), B. G. Thorell (Sweden), A. J.

Therkelsen (Denmark), Alice Stewart (England), and Dr. A. Sreenivasan (Bombay).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Dr. Prem Nath Satsangi (Lucknow), Dr. Mahendra Kumar Trambaklal Mehta (Patna), Dr. Gangadhar Vyankatesh Bhide (Bombay), Mr. Umakant Waman Kenkare (Bombay), Dr. Hargobind Jashanmal Mulchandani (New Delhi), Dr. Ram Krishna Arya (Lucknow), and Miss P. Parvathi (Calcutta).

## UTILIZATION OF SOUTH ARCOT LIGNITE CHAR AS DOMESTIC FUEL

C. V. S. RATNAM AND V. S. RAMANATHAN

*Lignite Investigation Lab., Neyveli*

THIS paper summarises the results of an investigation carried out on the use of South Arcot lignite char as domestic fuel. The development of a suitable and reasonably economic substitute for charcoal from South Arcot lignite<sup>1</sup> will go a long way in easing the domestic fuel situation, preventing cutting down of forests for domestic fuel supplies and finding better utilization for cow dung.

The char obtained by the carbonization of air-dried South Arcot lignite at about 500° C. in a locally designed and fabricated carbonizer, which can treat about 80 lb. of lignite at a time, was used in these tests. For the first series of five tests, the char was obtained from lignite from borehole number 161. In this case, 45 lb. of this material was carbonized at 510° C. In the second series of five tests, the char was from lignite sample from several boreholes and pit number 3 carbonized at 520° C. The charcoal available locally was used in the third series of tests.

Every test consisted of preparing boiled rice as per local household practice from weighed amounts of water, rice and fuel. About 200 g.

of fuel were weighed and equal quantities of rice and water were used in all tests. The same household hearth (open fireplace) was used in all the experiments.

A weighed amount of fuel was first placed on the grate, and ignited by a torch prepared from a small amount of coconut fibre dipped in kerosene. The fuel was allowed to catch fire and when the cooking was over, the rice vessel was removed from the hearth and the residual fuel was put in a closed container for cooling. Its weight was determined after cooling. The proximate analysis, calorific value and sulphur content of the samples of char and charcoal and the proximate analysis of the residual material were determined.

Table I gives the analysis (before and after use) of lignite char and charcoal used in the three series of tests, and also the actual consumption of the fuel. It shows that the volatile matter and ash contents of the lignite char are in line with those in charcoal, but the sulphur content in the former is more. The fuel consumption was calculated on moisture and ash-free basis.

TABLE I  
*Comparison of lignite char and charcoal as domestic fuel*

Material used	Series I 1-5 Expts. Lignite Char*	Series II 6-10 Expts. Lignite Char†	Series III 11-15 Expts. Charcoal
<b>BEFORE USE—</b>			
Moisture %	6.83	7.78	4.54
Ash %	6.06	7.07	4.54
Volatile matter %	7.62	10.57	13.01
Fixed carbon %	79.49	74.58	77.91
Calorific value B.T.U./lb.	12,090	11,770	12,780
Sulphur %	0.52	0.49	0.18
<b>AFTER USE—</b>			
Moisture %	8.94 to 10.00	8.84 to 9.73	7.27 to 8.70
Ash %	7.32 to 10.60	8.10 to 11.78	6.00 to 8.30
Volatile matter %	7.08 to 8.89	6.74 to 10.35	8.32 to 10.49
Fixed carbon %	71.57 to 75.95	68.03 to 79.76	74.74 to 77.57
Calorific value B.T.U./lb.	10,950 to 11,160	9,640 to 11,280	11,050 to 11,660
Sulphur %	0.62	0.63	0.19
Weight of material before use g. (moisture and ash-free)	244.1	170.3	254.8
Weight of material after use g. (moisture and ash-free)	151.4 to 166.9	87.3 to 97.8	129.9 to 150.3
Consumption of fuel g.	72.2 to 92.7	72.5 to 83.0	104.50 to 124.9
Average consumption g.	84.8	79.8	118.9

\* Lignite from several boreholes and pit No. 3 (pilot pit from which about 60 tons of lignite was raised).

† Lignite from borehole No. 161 (one of the boreholes dug for proving lignite bed).

TABLE II  
Details of experiments

Experiments	Material	Weight of fuel g.	Weight of residue g.	Ignition time min.	Total time min.	Weight of rice g.	Weight of water g.
I series, 1 to 5	Lignite Char*	280.2	185.3 to 200.6	6 to 9	33 to 35	350.3	840.7
II series, 6 to 10	Lignite Char†	200.0	105.45 to 119.3	7 to 8	31 to 34	363.8	1000.0
III series, 11 to 15	Charcoal	280.2	151.6 to 173.6	4 to 5	28 to 34	350.3	840.7

\* Lignite from borehole No. 161. † Lignite from several boreholes and pit No. 3.

Table II gives the data with regard to the details of the experiment.

These data indicated that the consumption of fuel was lower, when lignite char was used. The average fuel consumption in the first series was 84.8 g. for the charge of rice and water used, in the second series 79.8 g., and in the third series (when charcoal was used) 118.9 g. On the whole, lignite char consumption was 28.7% less than charcoal. The lower consumption of lignite char is in line with what was found by Ratnam *et al.*<sup>2</sup> in its utilisation as bus fuel. The per cent. reduction is about the same in both cases and the calorific value of the fuel is not a factor in fuel consumption in this case, as can be seen from the fact that charcoal has greater calorific value than the two lignite chars used. The nature and the burning qualities seem to be controlling factors here. Studies on this are under way.

The ignition time in the case of lignite char

was generally 3 to 4 minutes longer than when charcoal was used, but the total time taken for the entire cooking operation was about the same in both cases. Hence, no ultimate delay was involved in using lignite char as domestic fuel. Although the sulphur content in lignited char was higher than in charcoal, it was still low and in actual practice did not cause any inconvenience. As these tests were carried out in a kitchen using an open hearth in daily use, these observations will apply to the conditions that are likely to prevail in most houses in S. India.

The authors thank Smt. C. Sarojini Devi for her help in carrying out these tests and the Government of India for permitting the publication of these results.

1. Ratnam, C. V. S., *Madras Information*, August 1953, 44.
2. —, Ramanathan, V. S. and Veeraraghavan, S., *J. Sci. Ind. Res.*, 1955, 14 B, 604.

## BHILAI STEEL PROJECT

THE Government of India have accepted the detailed Project Report for the Bhilai Steel Works, furnished by the Soviet authorities. The proposed plant will consist of three blast furnaces for producing iron. By the use of high top pressure and sintering of iron ore, the output of the blast furnaces will be increased significantly. Steel will be produced by the straight basic open-hearth process in six open-hearth furnaces. Ingots produced will be 6-7 tons in weight. The large 1,150 mm. blooming mill will be capable of handling 10-ton ingots. The rolling mills are of modern design and layout, and incorporate technological improvements well proved in the U.S.S.R. The capacity of the plant will be, besides 300,000 tons of pig iron, 1 million tons of ingots yielding about

770,000 tons of rails, heavy and medium structurals, light structurals, sleeper bars and billets. With slight additions to the plant, such as an additional open hearth and a group of soaking pits, its capacity can be raised at any time to 1.3 million tons of ingots. No further additions of rolling mills will be required to finish the additional ingots. Apart from this, the plant will be so laid out that it can be expanded to produce up to 2.5 million tons of ingots.

The steel works are expected to achieve full production by December 1959, but two coke oven batteries, two blast furnaces, two open-hearth furnaces and the blooming mill will be commissioned about a year earlier.

## LETTERS TO THE EDITOR

	PAGE		PAGE
<i>New Emission Spectra of ICl and IBr—</i> P. B. V. HARANATH AND P. TIRUVENGANNA RAO .. .. .	184	<i>Effect of Extirpation of Neurosecretory</i> <i>Cells on the Metamorphosis of Iphita</i> <i>limbata Stal.—K. K. NAYAR .. .. .</i>	192
<i>Raman Spectrum of O-Fluorobromo-</i> <i>benzene—S. L. N. G. KRISHNAMACHARI</i>	185	<i>A New Cestode Senga lucknowensis, from</i> <i>Mastacembellus armatus Lacep.—G. N.</i> <i>JOHRI .. .. .</i>	193
<i>Relation between R.B.C. Count and</i> <i>Altitude—K. S. MURTY .. .. .</i>	186	<i>Anatomy of the Digestive System of</i> <i>Indian Mantis Sp.—S. V. RAJAN .. .. .</i>	195
<i>Highly Water-Reactive Forms of Transi-</i> <i>tional Elements of the Iron Group—</i> G. V. L. N. MURTY, D. SUBBA RAO AND T. R. RAMASWAMI .. .. .	187	<i>An Interspecific Hybrid of Grain Sorghum</i> <i>and Johnson Grass—S. halepense</i> <i>(2n = 20) × S. roxburghii (2n = 20)</i> —N. KRISHNASWAMY, V. S. RAMAN AND P. CHANDRASEKHARAN .. .. .	195
<i>Agar Electrophoresis of Hæmoglobins—</i> K. V. GIRI AND N. C. PILLAI .. .. .	188	<i>A New Species of Eimeria from a Cow-</i> <i>Calf in Bombay State—L. S. HIREGAUDAR</i>	197
<i>Effect of Addition of Iron Cobalt and</i> <i>Ascorbic Acid to the Medium on the</i> <i>Synthesis of Ascorbic Acid in Molds—</i> C. V. RAMAKRISHNAN AND P. J. DESAI ..	189	<i>The Development of Endosperm in Scilla</i> <i>indica Baker—D. A. GOVINDAPPA .. .. .</i>	198
<i>Effect of Aureomycin, Nitrite and Ricino-</i> <i>leate on Red Halophilic Bacteria—</i> R. VENKATARAMAN AND A. SREENIVASAN	190	<i>Immunisation of Cattle against Foot and</i> <i>Mouth Disease with Crystal Violet</i> <i>Vaccine—V. R. GOPALAKRISHNAN,</i> <i>C. SEETHARAMAN AND H. S. DHILLON ..</i>	199
<i>A Combined Technique for Maceration</i> <i>and Bleaching Osmium Blackening in</i> <i>Root Tips of Oryza—H. K. SHAMA RAO</i>	191	<i>The Intensity of Raman Lines in Spectra</i> <i>of Solutions of Pyridine in Acetic Acid</i> —ROMAN MIERZECKI .. .. .	200
<i>Treatment of Iron Chlorosis in Young</i> <i>Pear Trees—M. BAKR AHMED AND</i> <i>MAGDI TEWFIK .. .. .</i>	192	<i>A Case of Pleiotropy in Pigeon Pea—</i> R. B. DESHPANDE AND L. M. JESWANI ..	201

NEW EMISSION SPECTRA OF ICl  
AND IBr

New emission spectra of ICl and IBr have been obtained in condensed transformer discharge using a 20 K.V. transformer and in high frequency discharge using 50 and 100 watt oscillators. Spectra were photographed in the visible region with three prism Littrow and Fuess spectrographs, in the quartz ultraviolet region with a Medium Quartz instrument and in the fluorite region with a one metre normal incidence vacuum grating spectrograph.

The spectrum of ICl revealed an extensive system of about 300 bands in the region  $\lambda$  4400 to  $\lambda$  3800. These bands are sharp and are clearly degraded towards longer wave-lengths. The two systems reported in the fluorite region by Cordes and Sponer<sup>1</sup> in absorption are also recorded. The two well-known visible

systems reported in absorption are not observed in the present experiments. The emission spectrum of ICl as excited in an uncondensed transformer discharge consists of only a number of continuous bands in the region  $\lambda$  5650 to  $\lambda$  3700.<sup>2</sup> In addition to the above discrete band systems, our photographs reveal two continuous bands, one in the region  $\lambda$  4620 to  $\lambda$  4500 and the other at  $\lambda$  5350.

The spectrum of IBr has been excited under similar conditions. The characteristic bluish-violet emission surrounding the intense discharge due to the atomic line spectra, when photographed with a Fuess glass instrument revealed a brief system of about 25 bands in the region  $\lambda$  3900 to  $\lambda$  3800. In the fluorite region the two brief systems at  $\lambda$  1980 to  $\lambda$  1850 and  $\lambda$  1790 to  $\lambda$  1740 have also been recorded. The photographs also show some of the continuous bands which have earlier been re-

ported by Asundi and Venkateswarlu<sup>2</sup> in an uncondensed discharge through IBr.

Both the spectra of ICl and IBr have also been excited in a high frequency discharge from a 50 watt oscillator. The discrete band systems reported above are absent in this source, while the two brief systems in the fluorite region of each of these molecules have been obtained. The vibrational analysis of the two systems of ICl and IBr have led to the determination of the following vibrational constants.

TABLE I

		$\nu_{0,0}$ cm. <sup>-1</sup>	$\omega'_e$ cm. <sup>-1</sup>	$\chi'_e \omega'_e$ cm. <sup>-1</sup>	$\omega''_e$ cm. <sup>-1</sup>	$\chi''_e \omega''_e$ cm. <sup>-1</sup>
ICl	..	23824	173.2	1.1	209.7	1.9
IBr	..	25936	104.0	0.8	140.0	1.9

The two systems are analogous and arise from the same electronic transition. The lower state in each case is identified as a  $^3\Pi^1$  which is the upper state of the two low frequency systems of ICl and IBr observed in absorption. The electronic transition involved is

# RAMAN SPECTRUM OF O-FLUOROBROMOBENZENE

THE Raman spectrum of o-fluorobromobenzene was obtained in the liquid state. There is no previous report on the Raman spectrum of this compound excepting for the interpolated frequencies given by Kohlrausch.<sup>1</sup> Mercury 4358 Å radiation, filtered through the 'Du Pont Rhodamine 5 GDN extra' dye in p-nitrotoluene-ethyl alcohol solution, was used for excitation.

About 36 Raman lines were recorded and the shifts are given in Table I. Lines marked with asterisks were obtained as Stokes as well as antistokes lines. The depolarisation factors were determined by the simultaneous exposure method using a quartz double image prism to separate the horizontal and vertical components. The relative intensities of these two components were determined by the photographic method. The intensities of the lines, given in the second column of the table, are only semi-quantitative in that they are not corrected for the plate sensitivity variation. The abbreviations used to denote the appearance of the lines are: sh=sharp, vsh=very sharp, d=diffuse, vd=very diffuse, b=broad, and vb=very broad.

The author is grateful to Dr. G. C. Finger of the Illinois State Geological Survey for the

TABLE I

$\Delta\nu$	Int	App	$\rho$	$\Delta\nu$	Int	App	$\rho$	$\Delta\nu$	Int	App	$\rho$
157*	100	vb	.77	757	4	vd	.86	1157	13	sh	.81
189*	17	sh	.80	792	1	vb	..	1234	30	sh	.15
262*	32	b	.86	821*	34	sh	.18	1261	8	sh	.35
298*	56	sh	.36	845	2	b	..	1282	3	b	.71
441	1	b	..	874	1	b	..	1390	4	b	..
472*	14	vsh	.44	970	2	sh	..	1446	4	b	..
530*	4	vd	..	1001	1	vsh	..	1479	5	b	..
545*	29	b	.38	1026*	58	vsh	.15	1590	32	sh	.86
595	1	b	..	1049	2	bd	..	3020	4	vb	.62
654*	34	vsh	.16	1061	5	b	.23	3065	43	sh	.39
678	1	b	..	1115	6	sh	.44	3085	43	sh	
697	3	b	..	1136	2	sh	..	3173	4	vb	

identified as  $^1\Sigma^+ - ^3\Pi$  or case C equivalent  $0 \rightarrow -1$ , in accordance with the term scheme of ICl given by Mulliken.<sup>3</sup>

Full details will be published shortly.

Dept. of Physics, P. B. V. HARANATH.  
Andhra University, P. TIRUVENGANNA RAO.  
Waltair, February 16, 1956.

gift of the sample and to the Government of India for the award of a senior research scholarship. The author is deeply indebted to Prof. K. R. Rao for his valuable guidance.

Dept. of Physics, S. L. N. G. KRISHNAMACHARI.  
Andhra University,  
Waltair,  
April 15, 1956.

1. Cordes, H. and Sponer, H., *Zeits. fur. Phys.*, 1932, **79**, 170.
2. Asundi, R. K. and Venkateswarulu, P., *Indian J. Phys.*, 1947, **21**, 76.
3. Mulliken, R. S., *Phys. Rev.*, 1934, **46**, 549.

1. Kohlrausch, K. W. F., *Monats. f. Chem.*, 1947, **76**, 249.

## RELATION BETWEEN R.B.C. COUNT AND ALTITUDE

PIONEERING work on high altitude physiology was described by Haldane, Priestley, Douglas and Barcroft.<sup>1,2</sup> Since then it became well known that the red blood corpuscle count in man increases with altitude. Since at higher altitudes, the atmospheric pressure and consequently the partial pressure of oxygen falls considerably below normal, it is explained that the R.B.C. count and the hæmoglobin content of blood increase proportionately, to make up for the depleted oxygen absorption and thereby bring the total oxygen supply as near the normal requirement as possible.<sup>3,4</sup> Barcroft gave an empirical relation between the R.B.C. count and the altitude.<sup>5</sup> However, a mathematical relation between these two quantities, based on theoretical grounds, which could quantitatively predict the R.B.C. count at any specified altitude does not seem to have been worked out so far. The present note reports a study of this type.

Experiments at high altitudes and those with reduced oxygen tensions in laboratories at sea-level lead to similar results on R.B.C. count.<sup>1</sup> Thus, the problem is obviously governed by the same principles as the oxygen dissociation curve at various oxygen tensions. Hence the desired relation can be deduced from the following equation for the oxygen dissociation curve of blood<sup>6</sup>

$$Y = \frac{(100-S)e^h K_1 p}{(1+K_1 p)} \cdot \frac{(1+p)}{(1+p+K_2 p')} \quad (1)$$

where  $Y$  is the oxyhæmoglobin in blood,  $(100-S)$  is the hæmoglobin available for oxygen absorption,  $e$  is the base of natural logarithms,  $h$  is  $(eK-eH)$  which is constant for any individual blood,<sup>7</sup>  $p$  is the oxygen tension,  $p'$  is the carbon dioxide tension and  $K_1$  and  $K_2$  are constants. Since in ordinary atmosphere, the carbon dioxide tension  $p'$  is negligible, the last factor in the right-hand side of the above equation reduces to unity and the equation can then be transposed to the form:

$$(100-S) = c_1 Y + c_2 Y/p \quad (2)$$

where  $c_1$  and  $c_2$  are constants since  $h$  and  $K_1$  are constants.

Here  $p$ , the oxygen tension, is proportional to the atmospheric pressure and is therefore related to the altitude  $A$  by the well-known equation:

$$p = p_0 e^{-kA} \quad (3)$$

where  $k$  is a constant, and  $p_0$  is the oxygen tension at sea-level, again a constant.

Man's normal requirement of oxygen and the amount of oxyhæmoglobin in his blood, i.e.,  $Y$ , should be constant at any altitude. Thus the available hæmoglobin in his blood  $(100-S)$  and hence the R.B.C. count (say,  $n$ ) to which this hæmoglobin is proportional, should increase with altitude, in order to maintain  $Y$  constant. Thus equation (2) transforms to  $n \propto abe^k$  which may be put in the form

$$\log_{10} n = C + KA \quad (4)$$

where  $C$  and  $K$  are constants.

Thus, a plot of  $\log n$  against  $A$  should be a straight line according to equation (4); and the R.B.C. count  $n$  plotted against the altitude  $A$  should give an exponential curve, as against the empirical linear relation of Barcroft and others.<sup>3,5</sup> These are borne out by the straight line I and the curve II in Fig. 1, drawn for the experimental data given by Barcroft.<sup>5</sup> From observations of atmospheric pressures at various known altitudes<sup>8</sup> and from theoretical considerations,<sup>9</sup> the value of  $K$  is found to be  $3.92 \times 10^{-5}$ , while from the experimental data on R.B.C. count and from the graphs in Fig. 1, the value is calculated to be  $4.0 \times 10^{-5}$ . The agreement is very good, particularly since the data in support of this paper are from experiments on human subjects. This affords an additional proof of the validity of equation (4).

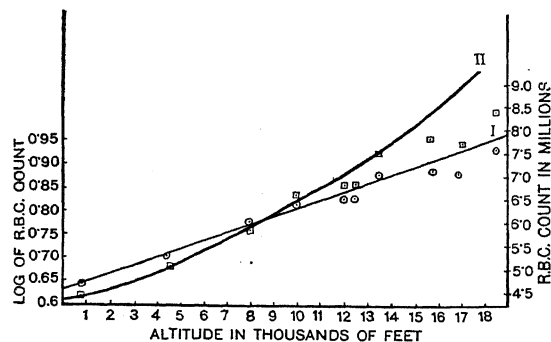


FIG. 1.

I  $\log_{10} n$  against  $A$ ; II  $n$  against  $A$ .

It is interesting to observe that at an altitude of 15,000 feet and above, the actual R.B.C. count is less than the theoretical amount required according to equation (4). This must be so because the R.B.C.-producing capacity of the body being limited, it is unable to supply the large amount of R.B.C. required at these altitudes. Thus, the symptoms of anoxia and mountain sickness become manifest at these altitudes and above.<sup>10</sup>

The author is grateful to Prof. K. V. Subbarao, Officer-in-Charge of the Regional Labora-

tory and to Prof. G. Gopala Rao of the Andhra University, for their interest.

Regional Laboratory, K. S. MURTY.  
Visakhapatnam-2, April 24, 1956.

1. Haldane, J. S. and Priestley, J. G., *Respiration*, New Haven, Yale University Press, 1935.
2. Barcroft, J., *The Respiratory Functions of Blood, Part I, Lessons from High Altitudes*, Cambridge University Press, 1925.
3. Bergin, Kenneth G., *Aviation Medicine, Its Theory and Applications*, John Wright & Sons, Bristol, 1949, pp. 20 and 21.
4. Mathews, B. H. C., "Effects of High Altitudes on Man," *British Medical Journal*, 1945, 2, 75.
5. Ref. 2, p. 138.
6. Murty, K. S., *Curr. Sci.*, 1955, 24, 364.
7. —, *Ibid.*, 1955, 24, 163.
8. Ref. 3, p. 180.
9. Mellor, J. W., *Higher Mathematics for Students of Chemistry and Physics*, Longmans, Green & Co., London, 1922, p. 62.
10. Glasser, Otto, *Medical Physics*, Year Book Publishers, Inc., Chicago, 1944, pp. 6 and 22.

#### HIGHLY WATER-REACTIVE FORMS OF TRANSITIONAL ELEMENTS OF THE IRON GROUP

In the course of our investigations on the isolation of non-metallic inclusions in steel by anodic dissolution of the base metal, we observed that the iron, deposited on the cathode under some specific conditions, showed remarkable reactivity with water even at room temperature (25° C. to 30° C.), accompanied by copious evolution of hydrogen. All the earlier studies on the reaction of iron with water<sup>1</sup> show that it is extremely slow at ordinary temperatures. Thus, the present observation seems to be rather unique and therefore systematic studies had been undertaken regarding the isolation and reactivity of this form of iron. The salient features of the interesting results obtained may be summarised as follows:

*Isolation.*—(i) It is necessary to have an electrolytic bath capable of resisting changes of pH, which should be maintained between 4 and 6. It should also prevent precipitation of iron as hydroxide by forming a complex with it. A strong solution of sodium citrate is very effective in this regard. (ii) The addition of an electrolyte like sodium chloride is helpful in increasing the conductivity of the bath and improving anodic dissolution. (iii) Sufficiently high current density is necessary to maintain the rate of deposition well above that of the reverse reaction of the active metal with the electrolyte. (iv) The reverse reaction can be

further minimised by keeping the bath at a fairly low temperature (20–25° C.). However, too low a temperature should be avoided for preventing the separation of the dissolved salts. (v) It is desirable to have as high a ferrous ion concentration as possible to offset the depletion of metal ions by complex formation. (vi) The reactive iron can be conveniently deposited on strips of platinum, aluminium, copper, nickel, iron or tin used as cathodes with pure iron as anode.

*Reactivity.*—(i) This form of iron reacts very readily with water even at room temperature (25–30° C.) accompanied by copious evolution of hydrogen, the reactivity being easily comparable to that of calcium. (ii) During the reaction, the pH of water progressively increases, resulting ultimately in a deep pink colour with phenolphthalein. (iii) Increasing the temperature of water greatly enhances the rate of reaction, the final pH being even higher than in the previous case. (iv) In all these experiments an inactive film forms on the surface along with the progress of the reaction. This in due course covers the entire surface, thus protecting the metal from further reaction. (v) The inactive film can be removed by dissolution in dilute acids or strong sodium citrate solution whereby a fresh surface of metal, showing the same reactivity with water, gets exposed and the reaction proceeds to completion. (vi) The deposited metal retains its activity for a few hours when kept dry under vacuum. Exposure to air and moisture renders the surface inactive, but if this is treated with dilute acids or strong sodium citrate solution, the reactivity manifests itself again, though markedly reduced in vigour. (vii) It has been found that at higher temperatures, the active form gets transformed to the inactive variety as evidenced by its inability to react with water.

Further work on the other two metals of the iron group, viz., cobalt and nickel, has shown that they can also be obtained in similar highly reactive forms. It may, however, be stated that the deposit of cobalt shows a fairly vigorous reaction with water, whereas, in the case of nickel the enhanced reactivity can be easily observed in very dilute acids with which other familiar forms of the metal do not react. Thus the water reactivity of these metals diminishes in the order of their positions in the Periodic Table.

We may recall in this connection that, to explain the well-known and rather anomalous high deposition potentials of the transitional



elements of the iron group, Glasstone<sup>2,3</sup> assumed their initial deposition in active metastable states. The present investigations clearly show that we have isolated similar reactive forms of these metals.

Further particulars will be published elsewhere.

G. V. L. N. MURTY.

D. SUBBA RAO.

T. R. RAMASWAMI.

Chemical Labs.,

Tata Iron & Steel Co., Ltd.,

Jamshedpur, April 9, 1956.

1. Rannan, E., *Ber.*, 1881, **14**, 1433.  
—, Schikorr, G., *Zeit. Electrochem.*, 1929, **35**, 62.  
—, Corey, R. C. and Finnegan, T. J., *A.S.T.M. Proceedings*, 1939, **39**, 1242.
2. Glasstone, S., *J. Chem. Soc.*, 1926, 2887.
3. —, *The Electrochemistry of Solutions* (Methuen), 1937, pp. 454.

### AGAR ELECTROPHORESIS OF HAEMOGLOBINS

THE agar electrophoresis technique<sup>1-3</sup> developed in this Department for the study of serum protein patterns has been applied to investigations of abnormal haemoglobins in human blood. A brief description of this technique is reported here in the hope that the technique being simple will be of considerable use in the routine examinations of blood for the presence of abnormal haemoglobins.

The haemoglobin solutions were prepared from citrate blood by the method of Drabkin,<sup>4</sup> without using aluminium chloride.

2-5 microlitres of the haemoglobin solution depending on the concentration is applied by paper strip application technique on the surface of the agar gel (1% containing veronal-acetate buffer of pH 8.6, ionic strength 0.05) and subjected to electrophoresis according to the procedure described before.<sup>2</sup> A voltage of 180-200 is used and the electrophoresis is carried out for 8-9 hrs. The current varies between 8-9.5 mA. After electrophoresis the haemoglobin bands can be seen clearly on the surface of the gel. If the concentration of the haemoglobin is low in the case of minor components, the band can be observed under ultra-violet light with Wood's filter. For quantitative evaluation of the bands, the agar gel, after drying is stained with Amido Black dye solution according to the procedure described before<sup>2</sup> and the densitometric evaluation of the components can be made by means of an electronic densitometer. Typical patterns of haemoglobins of normal blood and the blood of

a patient with a positive sickling trait (obtained from a case belonging to the aboriginal tribe, Kurumba, in Nilgiris), together with the densitometric curves obtained by a Photovolt Electronic Densitometer, Model 525, are shown in Fig. 1. It is clear from the patterns that

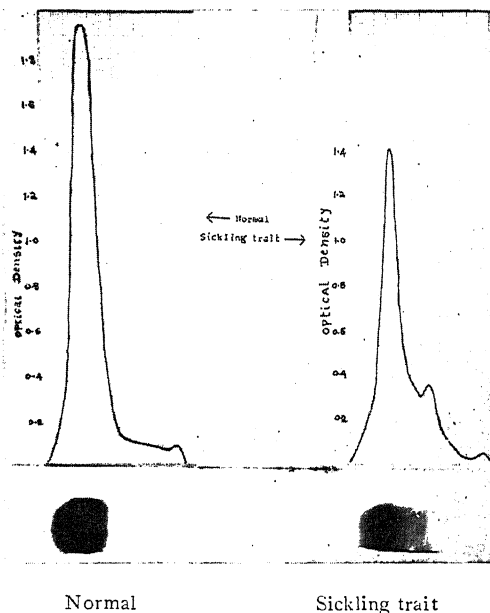


FIG. 1. Agar electrophoretic patterns of human haemoglobin types.

normal human blood shows a single haemoglobin component (Haemoglobin A), while that of the patient with the sickle cell trait shows the characteristic pattern, which consists of the major component, haemoglobin A and a minor component, haemoglobin S. The resolution of the two components is good and reproducible. Another characteristic feature of sickle cell trait pattern is that the haemoglobin bands are more diffuse than those of normal haemoglobin.

Another faint component towards the cathode side of the origin appears on the pattern in both normal and sickle cell trait blood. This component is an associated protein impurity which can be eliminated by repeated washing of the blood cells with saline solution. The agar electrophoretic patterns can also be obtained on cellophane or polyester films.<sup>3</sup> It may be noted here that the pattern is shifted slightly towards the cathode side due to electro-osmosis. Examination of chicken blood has shown two distinct haemoglobin components, whose mobility was found to be much lower than that of human haemoglobin. The faster moving component ( $\alpha$ -haemoglobin) is present

in lower concentration than the slower moving component ( $\beta$ -haemoglobin), which is in conformity with the observations made by Johnson and Dunlap.<sup>5</sup> A comparative electrophoretic pattern of chicken hemolysate and normal human serum protein is shown in Fig. 2. It

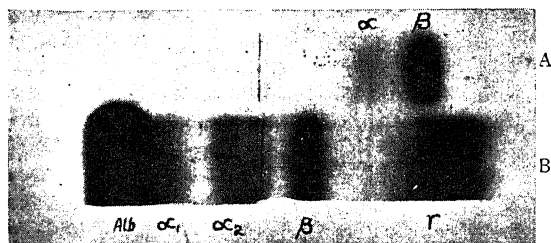


FIG. 2. Agar electrophoretic patterns of chicken haemoglobins and normal human serum proteins. (200 volts; 6.5 m.A.; pH 8.6; 0.05 I.S.; 6 hrs. run.)

A—Chicken blood haemolysate.

B—Normal human serum.

may be seen from the pattern that the mobility of the major component is slightly higher, while that of the minor component is much higher than that of gamma-globulin.

Investigations on the haemoglobin patterns of other animal species and normal as well as pathological blood cells are in progress. The agar electrophoretic technique being simple and inexpensive, affords an easy and convenient method for use in the investigation of abnormal haemoglobin traits in various populations in India. Full details of these investigations will be published elsewhere.

Our thanks are due to Mr. P. K. Sukumaran of 'Human Variation Unit', Indian Cancer Research Centre, Bombay, for kindly making available to us the hemolysate of sickle cell trait patient. The sickling phenomenon has been confirmed by him by microscopic examination.

Dept. of Biochemistry, K. V. GIRI.  
Indian Institute of Science, N. C. PILLAI.  
Bangalore-3 (India),  
May 3, 1956.

1. Giri, K. V., *Naturwissenschaften*, 1956, **43**, 36.
2. —, *Ibid.*, 1956 (In press).
3. —, *Ibid.*, 1956 (In press).
4. Drabkin, D. L., *J. Biol. Chem.*, 1946, **164**, 703.
5. Johnson, V. L. and Dunlap, T. S., *Science*, 1955, **122**, 1186.

## EFFECT OF ADDITION OF IRON COBALT AND ASCORBIC ACID TO THE MEDIUM ON THE SYNTHESIS OF ASCORBIC ACID IN MOLDS

THE synthesis of ascorbic acid by molds has been reported by several workers.<sup>1,2</sup> Certain interesting observations regarding the role of iron, cobalt and ascorbic acid in the biosynthesis of ascorbic acid by the mold (*Aspergillus flavus*) isolated from moldy groundnut seeds are recorded in the present communication.

The mold was grown in 25 ml. of the medium containing sucrose, 0.38 g.; sodium nitrate, 0.05 g.; dipotassium phosphate, 0.025 g.; magnesium sulphate, 1.025 g.; potassium chloride, 1.025 g.; and ferrous sulphate traces, (the pH of the medium was adjusted to 3.8 and autoclaved at 10 lb. pressure for 10 minutes) at 37°C. for 3 days. After the period of incubation, the mats were removed and extracted with 25 ml. of distilled water. The ascorbic acid content in the filtrate and the mat extracts was estimated spectrophotometrically using 2, 6-dichlorophenolindophenol. 0.5 ml. of the sample was taken in 25 ml. volumetric flask to which were added 5 ml. of citrate buffer, pH 3.8 and 12.5 ml. of 6% metaphosphoric acid and the whole diluted to 25 ml. To 5 ml. of this was added 5 ml. of 2, 6-dichlorophenolindophenol (1.6 mg./100 ml.) and the colour was read immediately at 520 m $\mu$  in Beckman DU spectrophotometer (1 cm. light path) against the blank containing all except the vitamin solution. A standard graph of optical density at 520 m $\mu$  against  $\mu$ g. ascorbic acid was plotted using standard amounts of ascorbic acid and the ascorbic acid present in the sample was calculated from this graph.

TABLE I

	Wt. of the mat in g.	mg. ascorbic acid in 100 ml. filtrate	mg. ascorbic acid in 100 g. mat
Complete system	0.2012	0.030	5.235
" +2 $\gamma$ Co	0.1456	0.100	9.131
" +4 $\gamma$ Co	0.1612	0.080	6.825
" +8 $\gamma$ Co	0.1752	0.040	6.525
" +2 $\gamma$ A.A.	0.1528	0.090	8.328
" +4 $\gamma$ A.A.	0.1621	0.060	7.710
" +8 $\gamma$ A.A.	0.1752	0.045	6.782
" -Fe	0.1752	0.050	6.526
" -Fe+2 $\gamma$ Co	0.1374	0.105	9.831
" -Fe+2 $\gamma$ A.A.	0.1483	0.110	9.528

Table I gives the result of the addition of different amounts of cobalt and ascorbic acid to the medium, with and without the addition

of iron, on the growth of the mold and the biosynthesis of ascorbic acid.

It is found that the biosynthesis of ascorbic acid is inhibited by the addition of iron, but that this depressing effect is countered by the addition of cobalt (2γ) or ascorbic acid (2γ). The effects of the addition of cobalt and ascorbic acid are more pronounced in the absence of iron.

Further work is under progress and the details will be published elsewhere.

Our thanks are due to the Chief Mycologist, I.A.R.I., Delhi, for identifying the mold.

Dept. of Biochemistry, C. V. RAMAKRISHNAN.  
Faculty of Science, P. J. DESAI.\*  
Baroda University, Baroda,  
January 24, 1956.

\* Post-graduate Student.

1. Max Geiger Huber and Heidigalli, *Verhandl. Natur.forsch. Ges. Basel.*, 1945, **56**, 37.

2. Ramakrishnan, C. V. and Srinivasan, K. S., *Science and Culture*, 1951, **16**, 320.

#### EFFECT OF AUREOMYCIN, NITRITE AND RICINOLEATE ON RED HALOPHILIC BACTERIA\*

THE red salt organisms known to be responsible for the reddening of salted fish<sup>1</sup> and hides cause considerable loss to the trade. Since Canadian workers<sup>2</sup> have successfully used aureomycin and nitrites in the preservation of

fresh fish, it was thought desirable to see if these could control the red halophiles also. Hess and Gibbons<sup>3</sup> have also studied the effect of NaNO<sub>2</sub> on red halophiles. The pure cultures used in these experiments were *Pseudomonas salinaria*, *Ps. cutirubra*, *Bacterium trapanicum*, *B. halobium*, *Micrococcus morrhuae*, *M. roseus halophilus*, *Sarcina littoralis* and *S. morrhuae*. Some cultures isolated and studied in this laboratory<sup>4</sup> also have been used. Aureomycin, sodium nitrite, and sodium ricinoleate were aseptically added to a modified salt-skim-milk-agar (pH 6.5 ± 0.1) and plates poured in 'Felsen' quadrant dishes. Surface inoculation was made by streaking. The inoculum was prepared in 20% sterile brine to give visible turbidity. Growth in the control and other media was recorded. The results are tabulated in Table I.

It is clearly seen that even 10 p.p.m. of aureomycin had no effect on the red halophilic bacteria. In fact, growth was as profuse and rapid as in control. There was not even a longer lag. No morphological changes were noticed in the rod forms or cocci grown in the presence of 10 p.p.m. aureomycin. This is in fact surprising because far smaller quantities of aureomycin suppressed mesophilic bacteria in fresh fish. The ineffectiveness of aureomycin in restraining infection due to red halophilic bacteria has been noted by Canadian workers<sup>7</sup> also. It is not clear whether the high Mg<sup>++</sup>

TABLE I  
Effect of aureomycin, nitrite and ricinoleate on red halophiles

Culture	Control	Aureomycin p.p.m.		Sodium nitrite %					Sodium ricinoleate %	
		4	10	0.05	0.10	0.15	0.20	0.5	0.2	0.5
<i>Pseudomonas salinaria</i>	..	++	++	+	-	-	-	-	++	++
<i>Ps. cutirubra</i>	..	++	++	+	-	-	-	-	++	++
<i>Bacterium halobium</i>	..	++	++	+	±	±	±	-	+	-
<i>Bacterium trapanicum</i>	..	++	++	+	-	-	-	-	-	-
<i>Sarcina littoralis</i>	..	++	++	++	++	+	+	+	-	-
<i>S. morrhuae</i>	..	++	++	++	++	++	+	-	-	-
<i>Micrococcus morrhuae</i>	..	++	++	++	++	++	+	-	-	-
<i>M. roseus halophilus</i>	..	++	++	++	++	++	+	+	=	-
H 18 ( <i>Halobacterium indicum</i> N.sp.)	}	++	++	0	0	0	0	-	-	-
H 41 ( <i>Halobacterium minutum</i> N.sp.)										
H 45 ( <i>Halobacterium gibbensii</i> N. sp.)										
H 36, H 15 ( <i>Sarcina</i> sp.)	++	++	++	0	0	0	0	++	0	0
H 46 ( <i>Sarcina marina</i> N.sp.)	++	0	0	0	0	0	0	-	-	-

++ = Excellent growth; + = Fair growth; ± = Poor delayed growth; - = No growth; 0 = Not tested.

\* Published with the kind permission of the Addl. Director of Industries and Commerce, Madras.

content (which is essential for better growth of red halophiles) of the medium reverses the toxicity of aureomycin, as has been suggested by Eagle and Saz<sup>4</sup> in the case of *B. subtilis* and *Ps. aeruginosa*.

The effect of nitrites is variable with different organisms. *Ps. salinarum*, *Ps. cutirubra* and *Bact. trapanicum* did not grow in the presence of 0.1%  $\text{NaNO}_2$ , though poor delayed growth was noted with 0.05%. *Bact. halobium* grew well in the presence of 0.05%  $\text{NaNO}_2$  but very slight growth was obtained even at 0.2% level, though not at 0.5%. In the case of the cocci growth was not retarded by 0.1%  $\text{NaNO}_2$ , though 0.2% delayed but did not arrest their growth. With 0.5% *M. roseus halophilus* still grew and *Sarcina littoralis* also showed delayed growth. Our laboratory cultures of *Sarcina* sp. (H 15 and 36) also grew well in this concentration of  $\text{NaNO}_2$ . Sodium ricinoleate had just the opposite effect. The cocci were suppressed but the rod forms grew even in 0.5% concentration with equal felicity as in control. The suppression of the cocci may be due to the depression of surface tension as reviewed by Werkman and Wilson.<sup>5</sup> High concentrations of nitrites are not recommended for edible articles such as salted fish but a combination of 0.2%  $\text{NaNO}_2$  and 0.2% sodium ricinoleate may be effective in salting hides.

We are grateful to Lederle Laboratories (India) Ltd., Bombay, for the gift of aureomycin.

Fisheries Technological Station, Kozhikode,  
March 12, 1956.

R. VENKATARAMAN.  
A. SREENIVASAN.

1. Venkataraman, R. and Sreenivasan, A., *Proc. Ind. Acad. Sci.*, 1954, **39B**, 17.
2. Tarr, H. L. A., Southcott, B. A. and Bissett, H. M., *Food Technol.*, 1952, **6**, 363.  
—, Boyd, J. N. and Bissett, H. M., *J. Agric. Food Chem.*, 1954, **2**, 372.  
— and Sunderland, P. A., *Progr. Rept. Pacific Coast Stars. Fish. Res. Bd. Can.*, 1939, **41**, 15.
3. Hess, E. and Gibbons, N. E., *J. Fish. Res. Bd. Can.*, 1942, **6**, 17.
4. Eagle, H. and Saz, A. K., *Ann. Rev. Microbiol.*, 1955, **9**, 173.
5. Werkman, C. H. and Wilson, P. W., *Bacterial Physiology*, 1952, Academic Press, Inc., New York.
6. Venkataraman, R. and Sreenivasan, A., *Proc. Ind. Acad. Sci.*, 1956, **43**, 197.
7. *Annual Report of the Fisheries Research Board of Canada*, 1954 (1955), 155.

## A COMBINED TECHNIQUE FOR MACERATION AND BLEACHING OSMIUM BLACKENING IN ROOT TIPS OF *ORYZA*

In a tropical country like India where high temperature prevails, the osmium present in tissues fixed with osmic combinations causes further blackening when the latter passes through the paraffin-bath at 56-58°C. The root tips of *Oryza*, chilled, fixed in La Cour 2BE, blocked, cut and bleached either with alcoholic hydrogen peroxide or with chlorine vapour gives very poor preparations after staining in crystal violet. Therefore it was found necessary to adopt other means of bleaching at room temperature.

Lee's *Vade Mecum*<sup>1</sup> lists several methods to remove blackening, of which some have been developed in connection with the animal material. Of the several methods listed, post-fixation treatments such as, soaking in aqueous solutions of chromic acid, bichromate of potash and in turpentine and dioxan were tried and found not suitable for *Oryza* root tips.

John McLeish<sup>2</sup> mentions the use of an equal mixture of saturated aqueous ammonium oxalate and 20 volume hydrogen peroxide as a method to soften and bleach the root tips of *Vicia faba* fixed in La Cour 2BD. A suitable technique for *Oryza* was worked out on a similar line. It was found that a weak concentration of the above mixture was sufficient with *Oryza* root tips.

The technique is as follows:

1. Fix root tips in La Cour 2BE (6-8 hr.).
2. Wash the fixed material in water (5 min.).
3. Soak the washed root tips in 1% aqueous solution of ammonium oxalate (10-15 min.).
4. Add to the above 3-5 drops of fresh 20 volume hydrogen peroxide. Control the intensity of reaction by dilution with 70% alcohol.
5. Wash the bleached root tips thoroughly for 15-20 min. in water.

Bleaching turns root tips to a pale yellowish colour in 5-10 min. The bleached root tips can then be blocked, cut and stained in crystal violet, after alcohol-chloroform or butyl alcohol series and can also be studied by the rapid method of squashing in a drop of propiono carmine.

The advantages of this technique are that osmium blackening is removed immediately after fixation, simultaneously rendering the material suitable for squashing; and staining is

normal both with carmine and crystal violet. The preparations obtained by the above method shows slender chromosomes, an important feature of the osmic fixed materials. Lastly, the usual acid hydrolysis is avoided as the oxalate helps to soften the root tips, making it suitable for squashes.

Central Rice Res. Inst., H. K. SHAMA RAO.  
Cuttack-4 (Orissa),  
January '31, 1956.

1. Bronte Gatenby, J. and Beams, H. W., *The Microtomists Vade Mecum*, 1950, 11th Ed., J. and A. Churchill Ltd., London, p. 24.
2. John McLeish, *Heredity*, 1954, 8, 386.

### TREATMENT OF IRON CHLOROSIS IN YOUNG PEAR TREES

DURING an investigation on chlorosis of young Le Conte pear trees grown in the nursery, a selected solution containing iron and manganese (1% manganese sulphate, 0.5% ferrous sulphate, 0.1% dref soap) was the most effective spray for curing such nutritional disorder. It was thought advisable to apply such a treatment on a large scale. Thus an experiment was designed at the nursery of the Faculty of Agriculture, Giza, using several chlorotic Le Conte plants grafted on *P. calleryana*. Serious chlorosis appeared on such plants at the beginning of April, especially on the top leaves. Spray treatments were started on April 24th and continued till September 25th. The plants of the present experiment were grouped as follows:

Group A.—Those plants were sprayed with the solution at monthly intervals.

Group B.—Those plants were sprayed with the solution once every other month.

Group C.—Those plants were left without any spray (control). Such latter plants included both green and chlorotic plants.

Each treatment included 150 plants. Leaf samples taken from the fully expanded top leaves were collected fortnightly from each

TABLE I

Group		Dry wt./leaf mg.	Ash %	Mn p.p.m.	Fe p.p.m.
Group A plants	..	251	5.7	35	98
Group B plants	..	261	5.9	39	107
Group C Green plants	..	259	6.1	39	112
Group C Chlorotic plants		137	8.0	23	155

group of plants for the determination of dry weight per leaf, ash percentage, manganese and iron content. Results are summarized in Table I.

There were marked differences between untreated green and chlorotic leaves. Chlorosis markedly reduced the dry weight and manganese content of leaves while increased the ash and iron content of chlorotic leaves. As regards the chlorotic plants sprayed with 1%  $\text{MnSO}_4$ , 0.5%  $\text{FeSO}_4$ , 0.1% draft soap solution, there was a decisive recovery of all the sprayed plants within 6 days. Such plants regained their growth activity and the newly developed leaves were green and healthy. No doubt there was an increase in the dry weight of leaves of the treated plants. Such leaves can be compared favourably with those normal green leaves as regards their dry weight, ash, manganese and iron content. There was no difference, however, between the leaves of plants sprayed with solution once every month or every other month.

Thus it may be concluded that spraying the chlorotic young pear trees with such solution has proved to give highly satisfactory results. Such successful results were obtained whether the plants were sprayed with this solution at the rate of one spray each month or each other month. The recovered plants were much similar to those normally green ones.

M. BAKR AHMED.

Faculty of Agriculture,  
Cairo University, Cairo, and

MAGDI TEWFIK.

Horticulture Section,  
Ministry of Agriculture,  
Cairo, February 3, 1956.

### EFFECT OF EXTIRPATION OF NEUROSECRETORY CELLS ON THE METAMORPHOSIS OF *IPHITA LIMBATA* STAL.

THE role of the neurosecretory cells of the brain in inducing moulting, growth and metamorphosis has been studied fully in *Rhodnius* by Wigglesworth.<sup>1</sup> He demonstrated that implantation of portions of brain containing the neurosecretory cells from nymphs one week after feeding, i.e., just around the "critical period" into the abdomen of nymphs decapitated soon after feeding, causes them to moult. Subsequently he<sup>2</sup> pointed out that the thoracic glands undergo cyclical development under the influence of the brain, which is responsible for

the moulting in the insect. Similar relationship between brain cells and the thoracic glands or their homologues have been recorded by Williams<sup>3</sup> in diapausing *Platysamia*, by Rahm<sup>4</sup> in *Sialis* and by Possompes<sup>5</sup> in *Calliphora*.

While studying the physiology of the neurosecretory cells of *Iphita limbata* Stal. (Phyrrhocoridae: Hemiptera) experiments were done to elucidate their function in the last nymphal instar. The neurosecretory cells of this insect form very conspicuous, paired clusters on the pars intercerebralis of the brain.<sup>6</sup> Newly moulted last instar nymphs show slender abdomen with a circumference of approximately 12 mm. to 14 mm. After a few hours they feed and gradually the abdomen swells up. From ten to twelve days it measures about 20 mm. to 24 mm. in circumference. Soon the nymph moults into the imaginal instar. In experimental studies, the neurosecretory cells of the pars intercerebralis were carefully extirpated from (1) nymphs after a full meal of plant sap, with abdominal circumference of 12 mm. to 17 mm., (2) nymphs with abdominal circumference of 20 mm. to 22 mm. and four to six days after feeding. Transplantations of three pairs of clusters of neurosecretory cells of the late nymphs (16 mm. to 21 mm.) into the early nymphs deprived of their neurosecretory cells a few days earlier, were also done. The operated insects were rather inactive and sluggish and were reluctant to feed.

Nymphs with slender abdomen with their neurosecretory cells removed, failed to develop the imaginal characters, though some of them survived the operation for about sixteen days. But when neurosecretory cells from late nymphs were implanted into the thorax of such insects, they promptly showed the development of the imaginal bodywall. However, they failed to moult completely and emerge out probably due to some physiological weakness. Also nymphs, five or six days after full feed and with swollen abdomen, did not fail to metamorphose into the imaginal instar in spite of the removal of their neurosecretory cells.

The above findings prove that the neurosecretory cells of the pars intercerebralis of the brain of *Iphita* have an important role to play in the activation and moulting in metamorphosis. It is conditioned by stimuli after a full meal. When extirpation is done early enough it brings about failure of moulting and metamorphosis; if done later the neurosecretory

cells have already initiated the moulting cycle and so moulting occurs.

Dept. of Zoology, K. K. NAYAR.  
University College,  
Trivandrum, February 21, 1956.

1. Wigglesworth, V. B., *J. Exptl. Biol.*, 1940, **17**, 201.
2. —, *Trans. IX Internat. Congr. Ent.*, 1953, **2**, 51.
3. Williams, C. M., *Biol. Bull.*, 1947, **93**, 89.
4. Rahm, U. H., *Rev. Suisse Zool.*, 1952, **59**, 173.
5. Possompes, B., *Arch. zool. expt. et gen.*, 1953, **89**, 203.
6. Nayar, K. K., *Biol. Bull.*, 1955, **108**, 296.

### A NEW CESTODE *SENGA LUCKNOW-ENSIS* FROM *MASTACEMPELLUS ARMATUS* LACEP.

DURING an examination of about two dozen specimens of the Indian fresh-water fish, *Mastacembellus armatus* Lacep., three complete cestodes and two incomplete strobilæ were obtained from the intestine of two of these fishes. These, on examination, appeared to represent a new species of the genus *Senga* Dollfus, 1934.

*Senga lucknowensis* N.SP.—The length of the three complete specimens vary from 210 to 212 mm. The scolex is pear-shaped, narrow anteriorly and broad posteriorly. It bears a pair of fleshy bothria terminating anteriorly in a disc which is notched on two sides. The disc bears two half crowns of hooks which vary in size. The sizes of the scolesces, the number of hooks, and their measurements are given in Table I.

TABLE I

Length of scolex mm.	Length of bothria mm.	Number of hooks	Size of the hooks	
			Large	Small
1.95	1.25	39	69 × 12 μ	40 × 7 μ
1.85	1.06	48	79 × 12 μ	35 × 7.5 μ
1.24	0.86	47	75 × 15 μ	20 × 4.5 μ
1.34	1.00	46	65 × 15 μ	27 × 6 μ
1.82	1.16	36	60 × 6.5 μ	50 × 5 μ

A distinct neck is absent. Some of the anterior immature segments are more or less square measuring 0.61 × 0.78 mm., while the mature and gravid segments of the middle and the posterior regions are much wider than long measuring 0.39 × 1.27 mm. The genital organs appear to develop in segments 25 mm. behind the head. In the region of the mature segments the successive segments are not well demarcated, so that there is often no true correspondence between the proglottides and the

genital sets. Certain proglottides may, therefore, seem to be apparently containing partly

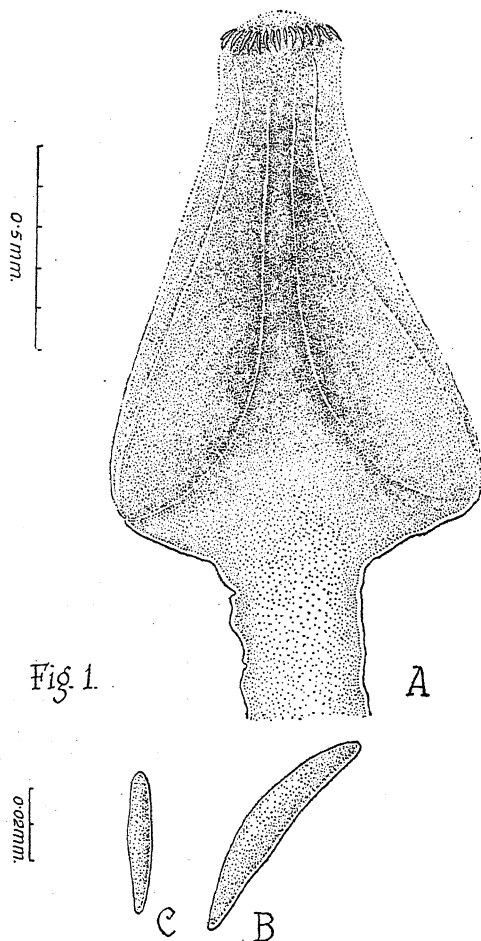


FIG. 1. A. Scolex of *Senga bucknovensis*. B. Large hook. C. Small hook.

or wholly some portion of the next genital set. But, in the region of the gravid segments, the

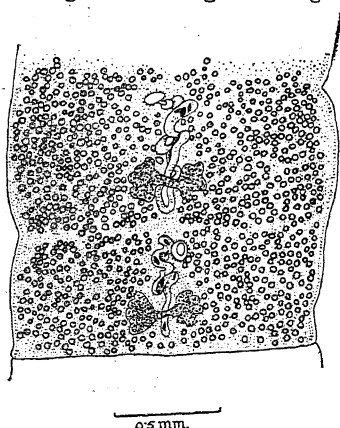


FIG. 2. Mature segment.

outlines separating the proglottides are fairly well de-lineated. In the mature segments the testes are numerous and around the ovary, located in the medullary region of the strobila, and measure  $40 \times 43-46 \mu$ . The cirrus sac is not clearly seen in whole mounts but in transverse sections it appears as a highly muscular structure with a coiled cirrus. The cirro-vaginal opening is situated anterior to the ovary on the dorsal side in the median line. The ovary is a bi-lobed structure situated in the hinder region of the proglottid. The lobes measure  $150-190 \mu \times 100-113 \mu$  each, and are about apart, connected by a narrow isthmus. The uterus is anterior to the ovary and it winds anteriorly in a very irregular fashion making about 7-10 turns. Eventually it dilates into a large uterine sac measuring  $200-230 \mu$  in diameter, opens ventrally either to the right or to the left of the median line. In the gravid segments the uterine coils are not distinct due to

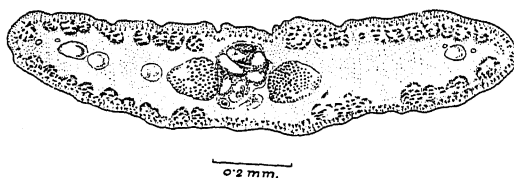


FIG. 3. Transverse section of a mature segment.

the large number of eggs contained in them. The vitelline follicles are situated in groups in the cortical parenchyma. Their continuity is interrupted on the mid-dorsal and mid-ventral lines. The two excretory canals are visible on each side of the proglottides in transverse sections and they are almost of the same diameter. The eggs are oval, thin-shelled and without opercula. They measure  $46-60 \mu \times 24-28 \mu$ .

The genus *Senga* Dollfus,<sup>1</sup> includes three species, *S. besnardi* Dollfus,<sup>1</sup> from France, *S. ophioccephaliana* Tseng,<sup>2</sup> from China and *S. pycnomerus* Woodland,<sup>3</sup> from India. The present form can be distinguished from *S. pycnomerus* mainly by the fewer number of hooks on the bothria, by the greater number of testes and also by the smaller size of its mature segments. From *S. besnardi* the present form differs in having larger hooks on the bothria, a bi-lobed ovary and also in having its vitellaria interrupted along the mid-dorsal and mid-ventral lines of the segments. The present form differs from *S. ophioccephaliana* in the smaller size of its hooks and testes, larger size of its uterine sac and also in the location of the vitellaria. Moreover, the present form appears to be much larger in size than the other known species.

Hence it is regarded as a distinct species and named *Senga lucknowensis* n. sp.

The author is highly thankful to Prof. M. B. Lal for his guidance.

Dept. of Zoology,  
Lucknow University,  
Lucknow.

G. N. JOHRI.

1. Dollfus, R. Ph., *Bull. Soc. Zool. France*, 1934, **60**, 476.
2. Tseng, Shen, *J. Sci. Nat. Univ. Shantung, Tsingtao, China*, 1933, **2**, 1.
3. Woodland, W. N. F., *Parasitology*, 1924, **16**, 441.

### ANATOMY OF THE DIGESTIVE SYSTEM OF INDIAN MANTIS Sp.

A DETAILED study of the digestive system in a number of species of Orthoptera was made by L. Bordas as early as 1898, but very little information is available on the Mantidae of India. The author's observations on these are recorded below.

In *Mantis* Sp., the alimentary canal consists of oesophagus, crop, gizzard, mesenteron and hindgut. The oesophagus extends upto mesothorax followed by the crop. On either side of the oesophagus lie a pair of salivary glands. Each gland is made up of a number of spherical lobules resembling a bunch of grapes. The glands are traversed throughout by a network of fine branches of tracheæ and canaliculi. The canaliculi join to form a salivary duct on each side and open anteriorly into buccal cavity. One of the lobes of the salivary gland on each side is very much reduced in size. In between the two glands lies a small, vesicular salivary receptacle, communicating with a pair of salivary receptacular ducts, joining the common salivary duct in front.

The crop is thin-walled and pyriform in shape, extending from metathorax to three-fourths the length of the abdomen, serving as a reservoir of food. The gizzard is pear-shaped, rudimentary and followed by eight enteric cæcæ. The enteric cæcæ are finger-shaped and open into the alimentary canal just behind the gizzard. The gizzard is internally lined by a number of chitin ridges. Perhaps due to carnivorous diet of the animal, the gizzard has been secondarily reduced in size and importance.

The gizzard is followed by mesenteron, a short, coiled tube of uniform diameter, internally lined by glandular epithelium. The peritrophic membrane is present.

The mesenteron is followed by hindgut and at the junction of the two, a large number of

hair-like malpighian tubules open into the alimentary canal. The hindgut is short, followed by an oval rectum, with a number of rectal papillæ.

The long and extensive foregut with a capacious crop, a rudimentary gizzard, a short mesenteron and hindgut, with well-developed salivary glands and enteric cæcæ of *Mantis* Sp. is well adapted for the carnivorous diet of the predatory animal. In phytophagous insects we find a well-developed gizzard and a longer mesenteron as in Tettigonidae and Aericidae. These observations are in agreement with that of Bordas.<sup>1</sup> Study of the histology of the digestive tube of *Mantis* Sp. is in progress, and a more detailed paper will appear shortly.

Dept. of Biology,

S. V. RAJAN.

J. S. S. College, Dharwar,  
March 23, 1956.

1. Bordas, L., *Ann. Sci. Nat. Zool. Paris*, 1909, **5**, 26.

### AN INTERSPECIFIC HYBRID OF GRAIN SORGHUM AND JOHNSON GRASS—*S. HALEPENSE* ( $2n=20$ ) × *S. ROXBURGHII* ( $2n=20$ )

Two chromosomal forms, viz.,  $2n=20$  and 40 have been reported from the Indian species of *S. halepense*.<sup>1,2</sup> The 20-chromosomed *halepense* is found to behave as a normal diploid in its meiosis.<sup>2</sup> Hybrids between *S. halepense* ( $2n=40$ ) and grain sorghums ( $2n=20$ ) have been reported by several workers.<sup>3</sup> A hybrid between the 20-chromosomed form and grain sorghum is reported here for the first time.

Fig. 1 shows the parents and the hybrid. A



FIG. 1. (a) *S. halepense* ( $2n=20$ ) (1/40 Nat. Size); (b) *S. roxburghii* var. *hians* ( $\times 1/55$ ); (c) Hybrid plant ( $\times 1/75$ ).



TABLE I

Characteristic	<i>S. halepense</i>	<i>S. roxburghii</i>	F <sub>1</sub> plant
Chromosome number (2n)	20	20	20
Plant height (cm.)	250	349	392
Stem thickness (diam. in cm.)	0.9	1.6	1.5
Number of tillers	30	0-1	20
Leaf length (cm.)	85	58	94.6
„ breadth (cm.)	3.5	8	5.5
„ margin	straight	wavy	slight wavy
Length of stomata (μ)	31.8	36.9	33.2
Panicle and axis	loose, thin	loose, thick	loose, intermediate
Spikelets	elliptic	ovate	ovate
„ drying colour	straw	bleached	straw
„ size	small	large	intermediate
Awns	nil	nil	short awns
Hairiness	hairy	glabrous	hairy
Grain shape	elliptic-obovate	ovate-rotundate	ovate-elliptic-ovate
„ size and exposure	small, enclosed	large, fully exposed	intermediate, half exposed
„ colour	brown	white pearly	brown
„ shedding	shedding	non-shedding	intermediate

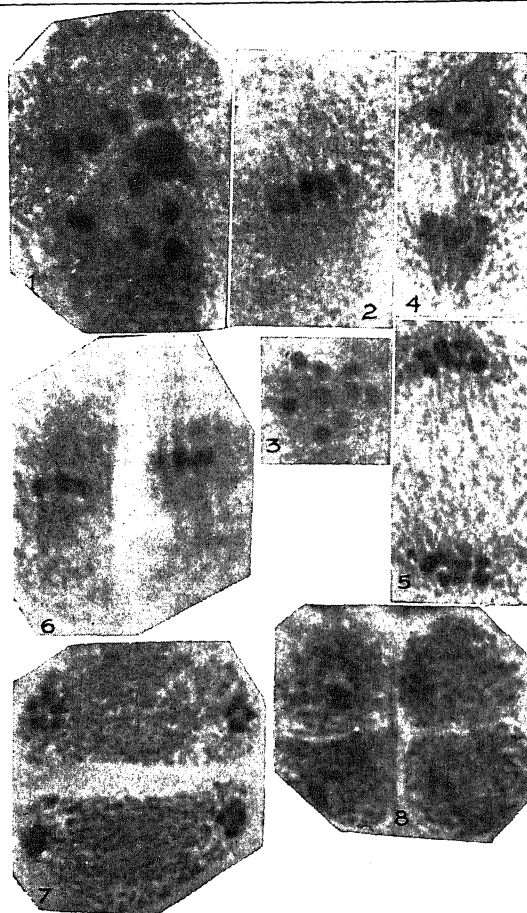


FIG. 2.—1. Diakinesis showing ten bivalents. 2. Metaphase-I side view. 3. Polar view of the same; one bivalent at ten o'clock position out of focus. 4. Anaphase-I. 5. Telophase-I showing ten daughter-bivalents at each pole. 6 and 7. Second meta and telophases. 8. Tetrads. (All microphotographs,  $\times 1,150$ .)

comparative statement of the important characteristics of the plants is given in Table I.

From Table I it is seen that the F<sub>1</sub> transgresses the parents in some characters, intermediate in others and in a few cases like the wild parent.

The meiosis of the hybrid is normal, giving ten bivalents at diakinesis, a normal bipolar spindle and congression at Metaphase-I. The anaphase shows ten daughter-bivalents separating and migrating to the poles. The second division also is typical giving well-formed tetrads (Fig. 2—1 to 8). The pollen is normal and 35.8% sterile.

The haploid of the grain sorghums has been observed to form 1 to 3 bivalents.<sup>4,5,6</sup> This would point to the probable duplication of chromosomes in the genome of the grain sorghum ( $2n=20$ ). The hybrid between the tetraploid *halepense* and the diploid grain sorghum is a 30-chromosomed plant in accordance with crosses involving parents with numerical differences in the genomes. The hybrid forms 3 to 6 trivalents indicating the probability of the 40-*halepense* being an allotetraploid. Based on the observations on a 20-chromosomed polyploid Duara and Stebbins<sup>7</sup> consider *S. halepense* ( $2n=40$ ) to be a segmental allopolyploid. The pairing in the present hybrid shows a complete homology between the genomes of the two parents. It may be assumed that the 20-chromosomed form is a genetical diploid of the 40-*halepense*. Thus the evidence seems to point more towards the autoallopolyploid nature of the 40-*halepense*. Otherwise the grain sorghum should also be segmental allopolyploid.

Snowden<sup>8</sup> has classified the subsection *Halepensis* of section *Eu-sorghum* into four spe-

cies, viz., (i) *halepensis*, (ii) *miliaceum*, (iii) *controversum*, and (iv) *propinquum*. According to his grouping, most of the Indian *halepense* plants fall under the last three, the species *miliaceum* and *controversum* having a wider distribution and *propinquum* being restricted to the south-east coast of India. So far only the species *halepensis* Snowden<sup>8</sup> has been utilized in these interspecific hybridizations. The present hybrid is between species *miliaceum*, Snowden<sup>8</sup> and grain sorghum.

A number of crosses back to the grain sorghum have been done in order to obtain good fodder and grain sorghum. A detailed account of the behaviour of the hybrid will be reported elsewhere.

N. KRISHNASWAMY.  
V. S. RAMAN.  
P. CHANDRASEKHARAN.

Cytogenetics Lab.,  
Agri. College and Res. Inst.,  
Coimbatore, March 12, 1956.

1. Raman, V. S. and Krishnaswamy, N., *Ind. J. Agric. Sci.*, 1955, **25**, 47.
2. Krishnaswamy, N. and Raman, V. S., *Proc. 3rd Sci. Workers Conf., Madras Agric. Coll. and Res. Inst.*, 1953, Supdt., Govt. Press, Madras, 1954, p. 58.
3. —, Durairaj, V. and Thangam, M. S., *Curr. Sci.*, 1953, **22**, 311.
4. Brown, M. S., *Jour. Hered.*, 1943, **34**, 163.
5. Kidd, H. J., *Ibid.*, 1952, **43**, 225.
6. Eadrizzi, J. E., and Morgan, D. T., *Ibid.*, 1955, **46**, 201.
7. Duara, B. N. and Stebbins, G. L., Jr., *Genet.*, 1952, **37**, 369.
8. Snowden, J. D., *J. Linn. Soc. London Bot.*, 1955, **55**, 191.

## A NEW SPECIES OF *EIMERIA* FROM A COW-CALF IN BOMBAY STATE

DURING the course of an earlier investigation into the coccidial fauna of domestic animals in Bombay State, Rao and Hiregaudar<sup>1</sup> recorded *Eimeria zurnii*, *E. bovis* (*smithi*), *E. cylindrica*, *E. bombayensis* and *E. khurodensis* as the causal agents of coccidiosis in cattle. Of these, the first four are common and pathogenic while the last one is of rare occurrence and not so pathogenic.

Recently, the present author came across an unknown species of *Eimeria* in a fecal sample sent by the Veterinary Officer, Mundaragi (Dist. Dharwar). On account of some of the distinguishing features the oocysts of *Eimeria* from Mundaragi are considered as new to science and are described here under the name of *E. mundaragi*. The fecal sample containing

the oocysts of *E. mundaragi* has been deposited in the parasitological laboratory of Bombay Veterinary College.

*Eimeria mundaragi* sp.—Oocyst oval or egg-shaped (Fig. 1) with one end slightly

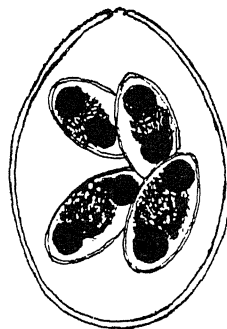


FIG. 1

pointed than the other and measures  $36-38 \times 25-28 \mu$ . Wall of the oocyst thin, smooth, transparent, pale yellow or yellow in colour and slightly thicker towards the micropyle end. Thickness of the wall of the oocyst  $0.3 \times 0.4 \mu$ . Micropyle distinct,  $0.5 \mu$  at the base and without a polar cap. Sporont  $15-20 \mu$  along the greatest diameter and finely granular in consistency. Sporocysts oval,  $14.8 \times 9.1 \mu$  with a thinning at the pointed end. Sporozoites  $4-6 \times 1-3 \mu$  and finely granular. Sporocystic residuum present. Cocystic residuum absent. Sporulation time 24-48 hours during summer.

*E. mundaragi* resembles *E. wyoningensis* in shape and size but differs from it in the colour of the wall of the oocyst which is pale yellow or yellow instead of yellowish or greenish brown and the sporulation time 24-48 hours instead of 120-168 hours. It also differs from *E. bombayensis* in possessing an egg-shaped oocyst instead of ellipsoidal or cylindrical and the wall of the oocyst thin, pale yellow or yellow instead of thick and pale yellowish brown.

As regards the pathogenicity of *E. mundaragi*, it is not possible to say anything unless it occurs in a pure form. The cow-calf from which the oocysts of the *E. mundaragi* were obtained had a mixed infection with *E. zurnii* and manifested severe dysenteric conditions and emaciation due to infection with the latter because of a large number of oocysts of *E. zurnii* present in the feces.

Bombay Veterinary College, L. S. HIREGAUDAR.  
Bombay, April 2, 1956.

1. Rao, S. R. and Hiregaudar, L. S., *Bom. Vet. College Mag.*, 1953-54, **4**, 24.

# THE DEVELOPMENT OF ENDOSPERM IN *SCILLA INDICA* BAKER

The development of endosperm in the so far investigated species of *Scilla*, one of the extremely interesting genera of Liliaceae, is recorded to be of the nuclear type.

After fertilization the embryo sac with the broad basal part is enclosed by the nucellar remains, the inner and outer integuments. The strong vascular supply of the ovule extends to the densely

nucleate chambers soon become binucleate after a nuclear division (Fig. 4). The two nuclei of the chalazal chamber do not undergo further divisions but become highly enlarged (Figs. 5-6) and often acquire an irregular shape (Fig. 7). This chamber with its dense vacuolate cytoplasm gradually extends towards the chalaza by crushing most of the cells (Figs. 5-6). Meanwhile the two nuclei of the micropylar chamber undergo repeated free nuclear divisions giving rise to a large num-

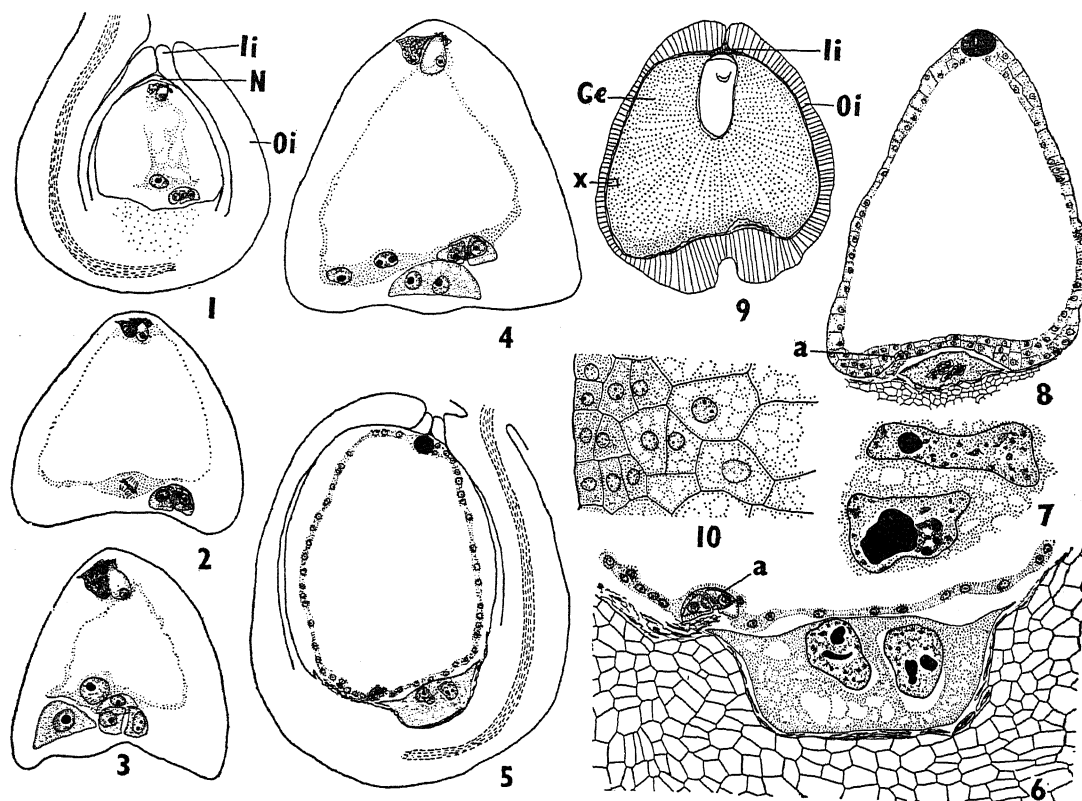


FIG. 1. L.s. ovule with embryo sac after fertilization,  $\times 49$ . FIGS. 2-3. First division of primary endosperm nucleus,  $\times 157$ . FIG. 4. Binucleate chalazal and micropylar chambers of the embryo sac,  $\times 157$ . FIG. 5. L.s. ovule,  $\times 47$ . Note the binucleate chalazal and multinucleate micropylar chambers of the embryo sac. FIG. 6. The chalazal chamber with surrounding parts of Fig. 5 enlarged,  $\times 151$ . Note the persisting antipodal cells. FIG. 7. Two nuclei of the chalazal chamber showing irregular shape,  $\times 483$ . FIG. 8. Cell wall formation in the micropylar chamber,  $\times 34$ . Note the degenerating chalazal chamber. FIG. 9. L.s. fairly old seed,  $\times 10$ . FIG. 10. A portion of endosperm at the mark  $\times$  in Fig. 9 enlarged,  $\times 209$ . (a, antipodal cells; Ce, cellular endosperm; Li, inner integument; N, nucellar remains; Oi, outer integument.)

cytoplasmic chalazal part. The primary endosperm nucleus is situated near the antipodal cells in the basal region (Fig. 1). Its first division is followed by a cell wall and the embryo sac, consequently, becomes divided into a small chalazal chamber and a very large micropylar chamber (Figs. 2-3). Both the uni-

ber of nuclei which remain embedded in a thin layer of cytoplasm at the periphery of the embryo sac (Fig. 5). Soon this is followed by a simultaneous cell wall formation (Fig. 8). The subsequent growth of endosperm is centripetal and the large central cavity of the embryo sac gradually becomes filled with the

endosperm tissue (Fig. 9). The peripheral cells of the endosperm are small with dense cytoplasm compared with the cells of the central region (Fig. 10).

As cell walls are laid down in the micropylar chamber, the activity of the chalazal chamber gradually declines and finally the chamber degenerates. During the development of endosperm, the embryo sac enlarges enormously, crushing the entire nucellus and the inner integument except an insignificant portion at the micropylar region (Fig. 9). The antipodal cells take deep stain and are persistent (Figs. 6 and 8).

The mode of endosperm development in *Scilla indica* is, therefore, not nuclear as in the other investigated species but Helobial. A careful investigation of the development of endosperm of the uninvestigated species of *Scilla* coupled with other embryological data may throw further light on the grouping of genera in the subfamily Scilloideæ.

It gives me great pleasure to record my gratitude to Professors K. N. Narayan and S. B. Kausik for their encouragement and guidance during the course of this investigation. I am highly thankful to Dr. M. S. Chennaveeriah for having collected the material for me near Bombay.

Dept. of Botany, D. A. GOVINDAPPA.  
Central College, Bangalore-1,  
May 26, 1956.

1. Buchner, Leopoldine, *Österr. Bot. Zeitschr.*, 1948, 95, 428.
2. Cave, Marion, *Plant Genera, Chronica Botanica*, 1953, 14, 140.
3. Schnarf, K., *Vergleichende Embryologie der Angiospermen*, 1931, Berlin.
4. Stenar, H., *Acta Horti Bergiani*, 1950, 15, 169.
5. Wunderlich, Rosalie, *Flora*, 1937, 32, 48.

#### IMMUNISATION OF CATTLE AGAINST FOOT AND MOUTH DISEASE WITH CRYSTAL VIOLET VACCINE

As early as 1938 Waldmann's method<sup>1</sup> of vaccination against Foot and Mouth Disease—a modification of Schmidt's original method<sup>2</sup> was extensively used in Germany. It consisted in treating the Foot and Mouth Disease virus and epithelium recovered from the tongue of cattle with aluminium hydroxide and formalin, thereby rendering the virus innocuous. This aluminium hydroxide "adsorbed" vaccine is also being used in other countries of Europe. The duration of immunity is reported to be for 6-8 months. Besides, other modifications have been

tried using crystal violet, chloroform, etc. Graub<sup>3</sup> made the first experiment using crystal violet dye in the preparation of the vaccine.

Under the auspices of the Indian Council of Agricultural Research, a research scheme is working at the Indian Veterinary Research Institute, Mukteswar, with the object of devising a suitable method of vaccination for the control of Foot and Mouth Disease among cattle in India. This is a disease of much economic importance as the losses due to reduced working capacity, diminished milk yield, deaths of affected animals, etc., amount to about 4 crores of rupees annually. A complicating and rather difficult factor to be reckoned with in the control of the disease is that there are three different types of virus, O, A and C, which are immunologically distinct and so a vaccine should be a polyvalent one containing the three types for general prophylactic measure. However, a mono- or a bivalent vaccine can with advantage be used in conducting preventive vaccination against any, one or two types respectively. This note gives a preliminary account of the preparation of and the successful immunisation of animals with crystal violet vaccine evolved at this Institute.

The polyvalent vaccine is prepared by reinforcing the blood, drawn at the height of thermal reaction from the reacting hill-bulls with 7.5% suspension of tongue epithelium, 2.5% suspension of each type of virus. The epithelium along with the lymph of vesicles on the tongue is collected aseptically from the bulls inoculated with a bovine strain of the virus. The material is weighed and then cut into very small pieces and triturated in a mortar. Sufficient quantity of buffer phosphate, pH 7.6, is added so as to enable centrifuging it for the removal of tissue particles. The blood collected from the hill-bull is incorporated. Finally crystal violet solution, sterilized at 60° C. for half-an-hour, is added in the concentration of 0.03%. The vaccine is now incubated at 37° C. for 10 days. Later, it is tested for purity, safety and potency. The dose for adult cattle is 30-40 c.c. given subcutaneously.

Experimental vaccination of animals both in the laboratory as well as in the field was carried out to assess the value of the vaccine. 24 Buffalo-calves were vaccinated with the crystal violet vaccine monovalent type 'O' at Military Farm, Bareilly. They were tested for immunity in batches of six animals each after

an interval of four, eight, thirteen and seventeen months. The animals remained solidly immune up to 13 months while two animals out of the last batch tested 17 months after vaccination reacted mildly on challenging them with Foot and Mouth Disease Virus type 'O'. The control animals showed quite a severe reaction in all the tests. From the observations there is evidence of adequate immunity for about 17 months.

With a view to ascertain the comparative value of crystal violet vaccine (Mukteswar) and the 'gel' vaccine bivalent types O and A (Copenhagen) a consignment of the latter was obtained from State Serum Institute, Copenhagen. Four hill-bulls, four sheep and four goats were inoculated with 32 c.c. and 15 c.c. each respectively and were tested for immunity 36 days after they were vaccinated. One of the hill-bulls, two goats and one sheep reacted severely. It is quite evident from the above observations that the immunity conferred by this vaccine was of shorter duration than that of crystal violet vaccine.

It has been found that crystal violet vaccine is simpler to prepare and is as efficacious as the "adsorbed" vaccine. There is experimental evidence indicating that the duration of immunity also is longer. Further work is in progress and efforts are being made for wider application of the vaccine in the field.

Div. of Pathology and V. R. GOPALAKRISHNAN.  
Bacteriology, C. SEETHARAMAN.  
Indian Vet. Res. Inst., H. S. DHILLON.  
Mukteswar, Kumaun, U.P.,  
April 20, 1956.

1. Waldmann, O., *Nature*, 1938, **142**, 58.
2. Schmidt, S., *C. R. Soc. Biol.*, 1936, **123**, 193.
3. Graub, *Schweiz. Arch. Tierheilk.*, 1939, 81.

### THE INTENSITY OF RAMAN LINES IN SPECTRA OF SOLUTIONS OF PYRIDINE IN ACETIC ACID

In his recent papers Lakshmanan<sup>1</sup> published the results of his study on the Raman spectra of pyridine solutions in fatty acids. He notices some displacements of the Raman lines of pyridine and also the appearance of a new line 1006  $\text{cm}^{-1}$  According to Lakshmanan, the intensity of the new line reaches a maximum for a solution containing 20 mol. % of pyridine and 80 mol. % of acid.

Similar studies have been made in our laboratory. We have observed similar changes in the spectrum of pyridine, and particularly, the

appearance of a new line of frequency 1003-1007  $\text{cm}^{-1}$ , the exact frequency depending on the concentration of the solution.<sup>2,3</sup> This line was considered to be due to modified totally symmetric oscillations of a ring of pyridine molecules which form complexes with molecules of acetic acid. Attention was therefore directed to the pyridine solutions of acetic acid. We have examined the spectra of 13 solutions of different concentrations and have measured the frequency of Raman lines as well as the intensity of the new line 1003  $\text{cm}^{-1}$ .

For this purpose the spectra of all solutions were photographed on the same plate at the same conditions. Photometric graphs were then taken by means of a recording Moll-microphotometer. To measure the intensity of the 1003  $\text{cm}^{-1}$  line for that part of the spectrum between about 985 and 1035  $\text{cm}^{-1}$  the density contour was transformed into intensity contour by means of characteristic curves drawn for each plate. Some of these contours

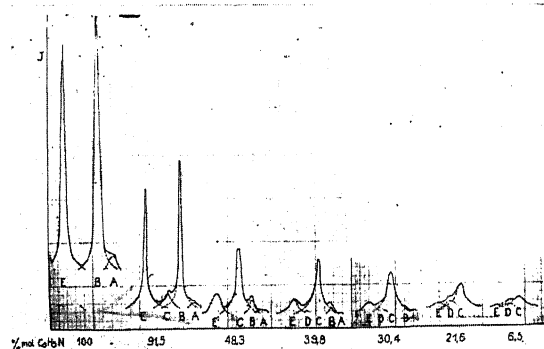


FIG. 1

are shown in Fig. 1. The intensity contours were carefully analysed and component lines separated. The latter are marked on Fig. 1 by dashed lines. The lines of pyridine  $e$ -989 and  $e$ -1029  $\text{cm}^{-1}$  are indicated by letters B and E respectively, the line marked by letter A is a  $f$ -1029 line. The new line of frequency 1003-1007  $\text{cm}^{-1}$  is marked everywhere by the letter C.

The intensity of this line was measured by integrating the area of this line. The results of measurements made on three series of spectra are represented by points on Fig. 2. The line drawn through these points represent the intensity as a function of the molar concentration of pyridine. In spite of the fact that the experimental errors are as high as 25%, it may be easily seen that the intensity for equimolecular solution takes on its maximum value.

During analysis of the spectrum of this solution, the  $989\text{ cm}^{-1}$  line was also discovered. From this it may be concluded that in such a solution, in addition to the pyridine molecules which form complexes, there are a number of free pyridine molecules.

The rough assumption is made that the scattering cross-sections of all the pyridine molecules forming complexes do not depend on the solution concentration. Considering that according to the law of mass action, the largest number of such pyridine molecules occurs for a solution in which the ratio of the number of pyridine molecules to the number of acetic acid molecules is the same as in the complex, it is concluded that the complex formed in the solutions investigated contains one molecule of pyridine and one of acetic acid.

The value of the ratio of intensity of the new line to the molar concentration of pyridine has no physical sense for the solutions containing more than 40 mol. % of pyridine, for, as we have seen, in such solutions complexes are not formed by all pyridine molecules present. In more dilute solutions, the value of this ratio decreases somewhat, but this decrease lies within the experimental error. Thus the assumption that the scattering cross-section remains constant for pyridine molecules forming complexes seems to be justified.

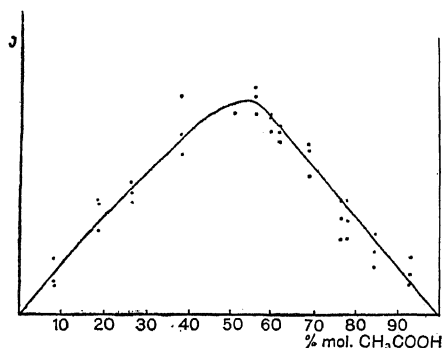


FIG. 2

In Fig. 1 for more dilute solutions, a line D of frequency near  $1020\text{ cm}^{-1}$  is also seen. So far, the existence of this line has not been explained. Kohlrausch<sup>4</sup> reported the existence of a very weak line of acetic acid of frequency  $1020\text{ cm}^{-1}$ . Under our working conditions this line has not been observed in spectra of pure acetic acid. It does not seem probable however that the line observed is a reinforced line of acetic acid. On the other hand, this line may constitute another modification of the  $989\text{ cm}^{-1}$  pyridine line. Formic acid has no line in this region, but in the spectra of solu-

tions of pyridine in formic acid containing 10 and 5 mol. % of pyridine, we have found lines of frequencies  $1022$  and  $1025\text{ cm}^{-1}$  respectively, in agreement with Lakshmanan's results. It is still an open question whether these lines have an analogue in the line  $1020\text{ cm}^{-1}$  observed in spectra of acetic acid solutions of pyridine, or whether they have to be identified as a displaced line of pure pyridine  $1029\text{ cm}^{-1}$ .

On the basis of the dependency of several physico-chemical constants on the concentration, Lakshmanan assumes that there are complexes built of one molecule of pyridine and four molecules of acid in solutions of pyridine and fatty acids. Lakshmanan's experimental results that the line  $1006\text{ cm}^{-1}$  has a maximum intensity in solutions containing 20 mol. % of pyridine seems to confirm his conclusions. These conclusions do not agree with those arrived at on the basis of the measurements presented in this paper.

Had there been a complex of the kind assumed by Lakshmanan and had it been manifested by a new line in the spectrum, it should have been the D line in Fig. 1, rather than that of  $1006\text{ cm}^{-1}$  frequency.

The author would like to thank Professor J. Pniewski for his interest in this work and his many valuable suggestions.

Institute of Physics, ROMAN MIERZECKI,  
Polish Academy of Science,  
Warsaw, Poland,  
April 26, 1956.

1. Lakshmanan, B. R., *J. Indian Inst. Sci.*, 1954, **36**, 97, 214.
2. Mierzecki, R., *Acta Phys. Polon.*, 1953, **12**, 26.
3. —, *Bull. Acad. Polon. d. Sciences Cl. III*, 1955, 258, 262.
4. Kohlrausch, K. W. F., *Ramanspektren*, Leipzig, 1943, 5.

#### A CASE OF PLEIOTROPY IN PIGEON PEA

SINGH, BANSAL AND MITAL<sup>1</sup> recorded in pigeon pea [*Cajanus cajan* (L.) Millsp.] a new variant to which they gave a specific rank and designated it as *Cajanus obcordifolia* Singh. The variant possessed obcordate leaflets with mucronate apex and the petals constituting the keel of the flower were free and filiform. Normally the leaflets in pigeon pea are lanceolate, with acuminate apex and the petals forming the keel are joined together and are not filiform.

Inheritance studies, since conducted by the present authors, have shown that the variant described by Singh *et al.* yields fully fertile

hybrids when crossed with pigeon pea types having normal leaflets. In the several  $F_2$  progenies studied the ratios of "normal" to "obcordate" plants were observed to be 15:1 and 3:1, indicating the operation of a pair of duplicate genes. In respect of all the other plant characters, the variant behaves like any other variety of *Cajanus cajan*. There thus seems to be no reason to elevate it to a specific rank. *Cajanus obcordifolia* Singh may therefore be reduced to a synonym of *Cajanus cajan* (L.) Millsp. The variant is locally be-

crosses had lanceolate leaves, with acuminate apex, and non-filamentous keel.

It would thus appear that the characters, obcordate leaflets and filiform keel, were very closely associated in the segregants also. In the extensive segregating populations studied during the course of several years, no recombinations were noticed. This suggests that each of the pair of duplicate genes,  $l_1$  and  $l_2$ , etc., governing the mutant character is pleiotropic in effect. On the basis of the above results the genetic constitution of the parental strains

TABLE I

Cross	Generation	Leaflets : Lanceolate Apex : Acuminate		Leaflets : Obcordate Apex : Mucronate		Total number of indi- viduals	Expected ratio	P value
		Keel: non- filamentous	Keel: fila- mentous	Keel: non- filamentous	Keel: fila- mentous			
Kanpur Mutant $\times$ N.P. (C) 15	$F_2$	133	..	..	12	144	15:1	0.50 & 0.20
N.P. (C) 15 $\times$ Kanpur mutant	$F_2$	116	..	..	8	124	15:1	0.95 & 0.99
Kanpur mutant $\times$ N.P. 41	$F_2$	287	..	..	84	371	3:1	0.50 & 0.20
N.P. 41 $\times$ Kanpur mutant	$F_2$	115	..	..	34	149	3:1	0.80 & 0.50
[Kanpur mutant $\times$ N.P. (C) 15] $\times$ Kanpur mutant	B. C. 1	84	..	..	26	110	3:1	0.80 & 0.50
(Kanpur Mutant $\times$ N.P. 41) $\times$ Kanpur mutant	B. C. 1	70	..	..	65	135	1:1	0.70 & 0.50

ing designated as the "Kanpur mutant" as it was first located at Kanpur by Singh *et al.*

It was noticed during these inheritance studies that the obcordate type of leaflet was invariably associated with the filiform keel characteristic of the Kanpur mutant. Observations with regard to these characters, in the  $F_2$  and back-cross generations of crosses of the Kanpur mutant with other pigeon pea types, viz., N.P. 41 and N.P. (C) 15, are presented in the following table; the  $F_1$  plants of these

would be as follows:

Kanpur Mutant— $l_1 l_1 l_2 l_2$ ;

N.P. (C) 15— $L_1 L_1 L_2 L_2$ ;

N.P. 41— $L_1 L_1 l_2 l_2$  or  $l_1 l_1 L_2 L_2$ .

Division of Botany, R. B. DESHPANDE.  
Indian Agric. Res. Inst., L. M. JESWANI.  
New Delhi, April 9, 1956.

1. Singh, D. N., Bansal, R. K. and Mital, S. P., *Indian J. Agric. Sci.*, 1942, 12, 779.

#### DR. K. S. KRISHNAN

DR. K. S. KRISHNAN, Director, National Physical Laboratory, New Delhi, has been elected a foreign associate of the National Academy of Sciences, U.S.A., in appreciation of his services to science. The number of

foreign associates, elected to the Academy, is restricted to about 50, Dr. Krishnan has the unique distinction of being the first Indian to receive this honour.

## REVIEWS

Humidity. By H. L. Penman. (Published by the Institute of Physics, London, S.W. 1), 1955. Pp. 71. Price 5 sh.

Thirty-five years ago the Physical Society of London arranged for a 'Discussion' on hygrometry and published the results in a pamphlet. The principal methods used in the measurement of humidity were therein described and the discussions contained several matters of intricate detail. In an introductory article to it, Sir Napier Shaw, Director of the London Meteorological Office, wrote: "The conclusion at which I have arrived at is that the wet bulb is useless for temperatures just below freezing, and should be discarded. Descriptions of the endeavour to find a suitable formula abound in meteorological literature; but practically the subject has not advanced at all in my time".

It is therefore a matter of real satisfaction that the measurement of humidity in general, and the measurement of humidity at temperatures below the freezing point in particular, have made considerable advances in the last few years. A descriptive summary of the various methods of measuring humidity, incorporating these recent advances, is the subject-matter of the booklet by Penman in the useful series of monographs brought out by the Institute of Physics. The booklet will be found valuable by physicists and even more by meteorologists, the strongest point about it being the compactness.

Written for persons of the undergraduate-graduate level, it is naturally not so exhaustive on particular aspects as the Physical Society's 'Discussion' referred to. In the author's own words, the standard is what one would expect of a candidate to be selected as "a technical assistant to help in problems of atmospheric and soil humidity".

After giving an account of the nature of water vapour, and developing the theoretical aspects of water-vapour-air relation in two preliminary chapters, the methods of measuring humidity are described in five chapters under the heads: Measurement of absolute humidity; Dew point hygrometer in which is included the frost point hygrometer developed for use in aeroplanes by Dobson, Brewer and Cwilong; Wet and dry bulb hygrometer; the use of hygroscopic materials, which includes the hair and miscellaneous devices. A final chapter deals with the control of humidity.

The descriptions are clear but not exhaustive. Considering the importance of measurements of humidity in free air, some more details of the adaptations of the instruments for attachment to instruments used in atmospheric soundings would have been in place in the book.

In dealing with the wet bulb, the empirical work of Glaisher and the theoretical work of Normand could have been described with advantage. Glaisher's "factor" and Normand's theorems on the wet bulb form integral parts of the science of humidity (see for instance, articles on Humidity by Skinner and on Thermodynamics of the Atmosphere by Shaw in Vol. III of the *Dictionary of Applied Physics*).

On page 15, the author says: "If all the latent heat of vaporization has been supplied by the air, then this temperature  $T_w$  is known as the wet-bulb temperature". What is known as the wet-bulb temperature is the reading of a thermometer with wet muslin around its bulb. Such measured wet-bulb temperature should theoretically have the value  $T_w$ . It is therefore more appropriate to refer to  $T_w$  as the ideal wet-bulb temperature as distinct from the reading of a wet-bulb thermometer. In 1931 Normand suggested the name "saturation temperature" for this ideal wet-bulb temperature.

The above suggestions have been made with the idea that the author may consider them for a future edition. In the small space of 60 pages, the book contains a wealth of information, well presented and will greatly benefit the general scientist and the meteorologist.

K. P. RAMAKRISHNAN.

Reduction with Complex Metal Hydrides. By Norman G. Gaylord. (Interscience Publishers), 1956. Pp. 1046. Price \$15.

Lithium aluminium hydride (LAH), which was first used for the reduction of organic compounds only ten years ago, is now one of the most widely used reducing agents in organic chemistry, and an extensive literature on the application of LAH, sodium borohydride and other metal hydrides has accumulated. The present volume, which gives a very thorough coverage of the literature up to January 1953, is therefore an opportune publication. Entire papers on hydride reductions are few in comparison with the hundreds of papers which



deal *inter alia* with reactions involving the use of metal hydrides, and the author has carried out the stupendous task of a page by page examination of the leading journals and of *Chemical Abstracts*. Before proceeding to organic reductions with the hydrides the preparation and properties of complex metal hydrides are described. There are also chapters on inorganic reactions, reactions with organometallic compounds, and the use of complex metal hydrides for the determination of active hydrogen and for other analytical purposes. General considerations in the reduction of organic compounds with metal hydrides are then discussed. Ten chapters are devoted to a detailed account of the hydride reduction of organic compounds classified according to functional groups. For each group the products and yields from individual compounds are listed in tables accompanied by charts of structural formulæ. A chapter is devoted to the behaviour of LAH towards carbon-carbon multiple bonds, and the complex data are summarized very clearly. A chapter on miscellaneous reactions gives an excellent account of hydrogenolysis by LAH and of Ziegler's recent and important work on the synthesis and applications of aluminium alkyls. Two particularly useful chapters describe the experimental conditions for hydride reactions in the laboratory and on a commercial scale, drawing attention to hazards and precautions to be taken.

The book appears to be produced by litho-printing from typescript, and the printing is in very clear type. The formulæ are remarkably clear. For an American book of 1046 pages, the price is very reasonable.

This is a carefully documented, comprehensive and scholarly monograph, which will be invaluable to every organic chemist for study and reference.

K. V.

**Theoretical Principles of Organic Chemistry, Vol. I.** By W. Huckel. (Elsevier's, London and New York), 1955. Pp. xi + 904. Price 77 sh. 6 d.

This truly ponderous work is a translation from the 7th edition of the original in German. It is a detailed record, in chronological order, of the important contributions that have been made towards an understanding of the theoretical principles of organic chemistry. The discussions include stereochemistry, organic molecular and complex compounds, free radicals, tautomerism, intramolecular rearrange-

ments, Walden inversion, reactions of unsaturated and aromatic compounds and course of certain chemical reactions. In most of these discussions, a good deal of space is devoted to older view-points to the exclusion at several places of more recent developments. The discussions do not necessarily suffer on this account and may serve as reminders that all fundamental theoretical advances in organic chemistry have not been made within the last few years.

A serious drawback of the book concerns the style in which it is written. The translation from the original is much too literal with the result that several passages have to be read over and over again before the meaning becomes clear. Lengthy and complicated sentences occur a little too frequently and retard easy reading.

In spite of this handicap, the book is still stimulating and worth careful study. There is no doubt that one can profit from its wide and critical survey of theoretical organic chemistry.

S. SWAMINATHAN.

**Polymyxin, Neomycin, Bacitracin.** (Antibiotic Monographs No. 5). By Ernest Jawetz. Foreword by H. Welch and Felix Marti-Ibanez. (Medical Encyclopædia, Inc., New York.) Pp. 96. Price \$4.00.

This monograph presents material of value to the pathologist and the clinician about the three antibiotics, which though not as widely used as penicillin, streptomycin or the tetracyclines, are nevertheless of value in special cases. Under each antibiotic, an informative account is given of what needs to be known regarding the history, chemistry, antimicrobial activity, absorption and excretion, toxicity, clinical use, etc. The indications and contraindications have been particularly stressed and the coverage of matter is thorough. There is a useful bibliography listing 205 publications; of these, only 17 on polymyxin originates from Britain, the rest are from America.

The get-up of the monograph and the printing are undoubtedly attractive and the reviewer agrees fully with the editors that "this clear concise monograph thoroughly covers the subject-matter". He also recommends it to those who wish to know about the clinical usefulness of polymyxin, neomycin and bacitracin, but the price is clearly a little too high.

K. GANAPATHI.

Silver Jubilee Souvenir, 1955. (Society of Biological Chemists, India), 1955. Pp. xvi + 262.

The *Silver Jubilee Souvenir* of the Society of Biological Chemists, India, is an interesting volume containing contributions from eminent biochemists both in India and abroad. The subjects dealt with are varied and include: A Colorimetric Method of Assay and the Partial Purification of Beef Liver Esterase, The Biochemistry of Human Genetics, Visual Pigments, Ascorbic Acid and Hydrogen Peroxide in Metabolism, Biochemistry of the Labile Methyl Group, Hypothermia and Its Induction by Drugs, Diabetes as a Disturbance of Carbohydrate Metabolism, The Role of Nucleotides in the Biosynthesis of the Nucleic Acids, Biochemical Engineering, Deuterium Exchange between  $\beta$ -Lactoglobulin and Water, Alkaloids from the Leaves and Roots of *Rauwolfia canescens* L., etc. This makes the volume a brilliant record of some of the achievements in the field of biochemistry during recent years.

The fact that several biochemists from other countries have contributed to this volume, shows the goodwill which the Society of Biological Chemists enjoys in the international field. The *Souvenir* is a fitting memorial to the Silver Jubilee of the Society.

M. V. R.  
S. M. P.

Annual Report for 1954-55 Nutrition Research Laboratories. (Indian Council of Medical Research, Coonoor, S. India), 1955. Pp. 36.

The booklet under review gives in detail the work carried out by the Nutrition Research Laboratories, Coonoor, during the year 1954-55. The research work relates to studies on vitamins, proteins, fats and investigations carried out in the nutrition clinic and in the field as also on a research project connected with protein malnutrition. Further, the interrelationship between rice diet and fertility has also been studied. Among the important findings, special mention may perhaps be made of the development of a fluorimetric method for vitamin A determination, the unusual observation that a certain species of amaranthus known as "Raj-keera" has a high content of lysine, the effective treatment of a number of cases of 'Kwashiorkar' with Bengalgram and Bengalgram-rice-calcium lactate diets and a study of the role of material malnutrition in 'Kwashiorkar' by clinical and biochemical findings in two hundred antenatal cases. Further, animal experiments with albino rats carried out under rigidly

controlled conditions have shown no difference in the fertility rate of animals maintained on 'rice diets' and 'wheat diets'. In regard to maintenance requirements of proteins in young adults, the report could have been more explicit, particularly in regard to the definition and calculation of biological value (B.V.), egg replacement value (E.R.V.) and negative nitrogen balance. However, the results obtained with five healthy young adults appear very interesting and should be confirmed by carrying out similar experiments on a larger number of persons. The report gives in the end a list of scientific meetings held, education and advisory work carried out and the titles of eighteen publications in *Indian Journal of Medical Research* and other scientific journals. One is indeed struck by the remarkable progress made in different fields of nutrition research during the period under review. It is to be hoped, that in the years to come, much more impressive and useful work will be carried out by this premier research institution devoted to a study of all aspects of nutrition research in this country.

P. S. SARMA.

Recent Research on Vitamins. (*British Medical Bulletin*, Vol. 12, No. 1.) (The Medical Department, The British Council, 65, Davies Street, London, W. 1), 1956. Pp. 90. Price 15 sh.

This brochure published as a memorial to the late Sir Edward Mellanby, will be welcomed by many scientists in India, particularly because they had the opportunity of meeting him and knowing him during the period he was in this country as the first Director of the Central Drug Research Institute at Lucknow. The introduction written by Sir Rodolph Peters and an appreciation of Mellanby by Sir Charles Harington precede the seventeen articles written on different vitamins by several English authors. The articles are more in the nature of reviews, giving the latest position of that subject and the possible future lines of development in that particular field.

Special mention may perhaps be made of the article on 'Vitamins and the Protection of the Liver' in which C. H. Best, C. C. Lucas and J. H. Ridout discuss in detail the role of active methionine and other lipotropic factors. L. J. Witts has reported in another article the recent work on B vitamins in the blood and gastro-intestinal tract, especially in relation to human diseases. There are two articles by H. M. Sinclair in regard to the relationship

which exists between vitamins and the nervous system, and vitamins and skin. R. A. Morton and T. W. Goodwin have reviewed the present position in regard to carotenoids and vitamin A, while Thomas Moore has reviewed the present status of our knowledge in regard to vitamin E. Among other articles of interest are one on vitamin B<sub>12</sub> by Lester Smith, another on vitamin C by L. J. Harris and a third by C. E. Dalglish on the interrelationships of tryptophan, nicotinic acid and other B vitamins, while the last three articles are on (i) anti-vitamins, antimetabolites and chemotherapy, by A. Albert, (ii) effect of processing on the vitamin content of foods, by L. W. Mapson, and (iii) vitamins in nutrition, orientation and perspectives, by B. S. Platt.

All the articles may be considered to be satisfactory in so far as they relate to the nutritional and medical aspects of any particular vitamin, but they are not as comprehensive as the title 'Recent Research on Vitamins' would lead one to believe. However, the objective was limited, in that the articles were chosen to reflect in a general sort of way the broad vision and the wide scientific activities of the late Sir Edward Mellanby. While not claiming to be very exhaustive, therefore, this booklet written in a very lucid style will still appeal to all interested in the medical and nutritional aspects of recent research on vitamins.

P. S. SARMA.

*Bird Navigation.* By G. V. T. Matthews. (Cambridge University Press), 1955. Pp. vi + 140. Price 12 sh. 6 d.

This monograph, in the Cambridge Experimental Biology Series, deals with one aspect of bird migration, the power of birds to find their way across unknown country. It is not merely an account of Dr. Matthews' experimental work in this direction, though that by itself is quite considerable, but a concise and critical summary of all scientific investigation so far in the study of bird navigation. Undoubtedly such work has added appreciably to our knowledge of the mystery of animal conquests of space and direction, but the clumsy words "knowledge of the mystery" are still necessary in view of the fact that even today we lack any complete and convincing explanation of the phenomenon. Dr. Matthews' ex-

periments with Manx Shearwaters and homing pigeons, and the summaries of the experimental releases of over 30 species of wild birds over short and long distances, make fascinating reading.

M. KRISHNAN.

*Mass Spectrometer Researches.* By G. P. Barnard. (Published by Her Majesty's Stationery Office, London, for D.S.I.R.), 1956. Pp. iii + 62. Price by post 3 sh. 9½ d.

The monograph describes the special features of an experimental sector-field mass spectrometer that was constructed at the National Physical Laboratory, England, and some of the experimental researches undertaken with this instrument. Various ion source designs of the electron bombardment type were examined with the aim of gaining a better understanding of the role of the magnetic field in the source region.

The researches described include work on the integrated effect of the fringing flux in sector-field instruments; on ion sensitivity and gas concentration with pseudo-molecular-beam arrangements; and on studies of voltage coefficients, peak shapes and ion transmission efficiencies for various source arrangements. The relationship between source magnetic field strength and mass resolution is also examined.

#### Books Received

*The Chemistry of Tanning Processes.* By K. H. Gustavson. (Academic Press), 1956. Pp. ix + 403. Price \$9.00.

*Frequency Response.* Edited by Rufus Oldenburger. (Macmillan Company), 1956. Pp. xii + 372. Price \$7.50.

*Methods of Biochemical Analysis*, Vol. III. Edited by David Glick. (Interscience), 1956. Pp. x + 437. Price \$9.50.

*Antibiotics Annual 1955-56.* Edited by Henry Welch and Felia Marti-Ibanez. (Interscience), 1956. Pp. xvii + 994. Price \$10.00.

*Carnegie Institute of Washington Year-Book*, No. 54, 1954-55. (Carnegie Institution of Washington, Washington 5 D.C.), 1955. Pp. xxxix + 311. Price \$1.00.

*Technique of Organic Chemistry*, Vol. IX. (Chemical Applications of Spectroscopy.) Edited by W. West. (Interscience), 1956. Pp. xxiv + 787. Price \$15.00.

## SCIENCE NOTES AND NEWS

### Occurrence of *Corchorus aestuans* L (= *Corchorus acutangulus* Lamk.)

Shri R. M. Datta, Department of Agriculture, Calcutta University, states that he observed *C. aestuans* (= *C. acutangulus*) occurring sparsely at an altitude of 2,200' in West Kurasia Hill (Vindhya Range) near Chirmiri in M.P. in November 1955. The plants were very stunted, and smaller than the Bengal specimens. This might probably be due to the altitude, but the sizes of the flowers and fruits were not altered. This is the first report from Madhya Pradesh.

### Cosmic Ray Activity, 22 Feb. 1956

The greatest burst of cosmic ray intensity ever recorded began at 9-45 p.m., 22 February, according to observations in the Chicago University. The event is described as the most outstanding example so far detected of the sun's production of cosmic ray particles. Onset of the outburst was recorded automatically at the University of Chicago's Enrico Fermi Institute for Nuclear studies. Balloons carrying apparatus to detect and report the cosmic ray outbursts were launched the following day. Such airborne apparatus is the first ever to be aloft during a cosmic outburst of the present intensity.

### Magnetic Refrigerator

A new type of cryostat that will maintain lower temperatures than any previous apparatus has been developed at Arthur D. Little, Inc., Cambridge, Mass. The design represents a major departure from ordinary refrigerating systems. It is based on a cyclic principle of magnetic cooling originated by Drs. John G. Daunt and Clifford V. Heer of the Ohio State University.

There are no moving parts or flowing fluids in this cooling system. It uses, instead, a plastic capsule 3" long, containing a special chemical salt as the refrigerant. Operation of the cryostat is controlled entirely by external magnetic fields.

The principle of magnetic cooling has been used for several years in a few cryogenic laboratories for achieving extremely low temperatures in the range of absolute zero. This is the first apparatus, however, that has been

able both to produce these extreme low temperatures and to maintain them for long periods of time. All previous equipment would immediately begin to warm up as soon as the low temperature had been reached.

### Multi-Purpose Food

A multi-purpose food has been evolved at the Central Food Technological Research Institute, Mysore. The product is similar in nutritive value and appearance to the multi-purpose food developed in America and is cheap, two ounces costing one-and-a-quarter anna only. The food is composed of a mixture of specially processed low fat groundnut flour and roasted Bengal gram flour, fortified with calcium salts, vitamins A and D, thiamine and riboflavin. It is available in two forms, seasoned (with salt and spices) for use in soups and savoury preparations and unseasoned for use in porridge, puddings and sweet preparations. The composition of the product per 100 g. is: protein, 41.9 g.; calcium, 0.665 g.; phosphorus, 0.820 g.; iron, 5.13 mg.; vitamin A, 3,000 I.U.; vitamin D, 250 I.U. and nicotinic acid, 14 mg.

Extensive consumer acceptability trials have shown that the product can be incorporated at levels ranging from 25-50% in various common food preparations based on cereals, without affecting their taste and acceptability.

### Shrimp Ground along Indian West Coast

A vast shrimp ground stretching more than 140 miles along the Malabar Coast, India, has been discovered by Mr. G. S. Illugason, an Icelandic master fisherman employed by the Food and Agriculture Organization (F.A.O.), on a fisheries mission to Madras State. Supplies are available in about a 4-mile wide strip stretching at least 140 miles from Beypore north to Mangalore. The shrimp average about 4-5" in length and are being caught by a small shrimp trawl, towed by a 10 H.P. open boat, at a rate of 100 lb. an hour.

The commercial and economic consequences of the discovery will be most favourable for the fishermen, who can now catch ten times as much during the mid-winter and spring and increase their earnings accordingly—if they have mechanized boats.

### Radioactive Yttrium in the Treatment of Cancer

Radioactive yttrium is the latest peaceful product of atomic energy to be used in fighting cancer. It is incorporated into a phase which is formed into a fine, flexible thread. The thread is then placed in diseased tissues where the radiations from the yttrium can have a curative effect. The plastic into which the yttrium is incorporated slowly dissolves in the tissues, leaving the source of radioactivity in the tissues to be treated. Yttrium is particularly easy to place in certain tissues, because it is not carried from place to place by body processes.

### NSF Institutes for Science and Mathematics Teachers

The National Science Foundation, U.S.A., will continue its programme of summer institutes for high school and college teachers. In addition, the foundation will support two experimental academic year institutes designed to assist colleges and universities in their efforts to improve science subject-matter training programmes for high school teachers of science and mathematics. Both programmes are directed towards strengthening the capacity of teachers to motivate students to consider careers in science and engineering by increasing the students' comprehension of basic science and mathematics. Now in its fourth consecutive year, the programme will provide opportunities for staff members of colleges and high schools to attend courses in the subject-matter of science and mathematics that are especially designed for teachers and that are conducted by faculty members noted for competence in their fields and for skill in presentation.

### Dr. Sampurnanand Prize

Dr. Sampurnanand, Chief Minister of Uttar Pradesh, has placed at the disposal of the National Academy of Sciences, India, a sum of Rs. 1,000 to be awarded as a prize to any Indian scientist who makes a contribution to our knowledge of Space Travel and its technique—physical, chemical, mathematical, psychological and physiological. The papers should be typewritten with double spacing on one side of foolscap paper and should not be more than 100 pages in length. Four copies of the paper should be submitted, of which only one copy should contain the name and address of the author on the title page. They should reach

the General Secretary, National Academy of Sciences, India, Lajpatrai Road, Allahabad-2, on or before 15th October 1956.

### The Correct Name of *Hemicyclia travancorica* Bourd

Sri. S. K. Jain, Herbarium, National Botanic Gardens, Lucknow, states that Pax and Hoffmann (1922) reduced *Hemicyclia* to a section of the genus *Drypetes* Vahl, and transferred all species of the former to the latter genus, except *Hemicyclia travancorica* Bourd. This species is a good *Drypetes*. The correct name of this therefore will be *Drypetes travancorica* (Bourdillon) Jain, *Comb. nov.*

### Raptakos Fellowships for Medical Research

The Raptakos Medical Research Board will consider applications for the award of fellowships for research work on medical and allied subjects in recognized institutions situated in the Union of India. The awards normally consist of Rs. 3,000 per year for a Fellowship and Rs. 750 per year towards special equipments or chemicals approved by the Board.

Applications in the prescribed form (which may be obtained from the Secretary and Treasurer, Raptakos Medical Research Board, Dr. Annie Besant Road, Worli, Bombay-18), should be submitted before September 30, 1956, for grants commencing from January 1, 1957.

### Birbal Sahni Institute of Palaeobotany

The Committee of Directors of the International Union of Biological Sciences have appointed Dr. D. C. Bharadwaj, Reader in the above Institute, as a member of the International Committee on Palynology (C.I.P.), Paris, France.

### Zoological Society of India

The Zoological Society of India has decided to publish small brochures of popular interest on zoological topics. Persons desirous of contributing articles in this scheme are requested to correspond with Professor M. B. Lal, Honorary Secretary, Zoological Society of India, C/o. Department of Zoology, The University, Lucknow.

### Award of Research Degree

The University of Poona has awarded the Ph.D. Degree in Physics to Shri Ananta Krishna Ramdas for his thesis entitled "Crystal Optics in Relation to Crystal Structure".

# Current Science

Vol. XXV]

JULY 1956

[No. 7

	PAGE		PAGE
Utilisation of Solar Energy .. ..	209	Obituary: Harry James Deuel, Jr.— J. GANGULY AND S. M. PATEL ..	216
Diamond as a Pinpoint Radiation Counter	212	Letters to the Editor .. ..	217
Controllable Thermonuclear Reactions by Means of Gas Discharges .. ..	213	Duty on Microscope Slides .. ..	235
Glycolytic Enzymes in Green Gram (Phaseolus radiatus)—K. V. GIRI AND T. RAMASARMA .. ..	215	Reviews .. ..	236
		Virus Research—T. S. SADASIVAN ..	240
		Science Notes and News .. ..	241

## UTILISATION OF SOLAR ENERGY

AS our resources of fossil fuel are being rapidly exhausted, the search for other sources of energy has become an important problem in recent years. Among the new sources, atomic energy and solar energy appear to be the most promising. Thanks to the rapid developments which took place during the last war, many of the problems connected with the practical utilisation of atomic energy have been solved during the last few years. It appears that even the energy of thermonuclear reactions may be regulated and made use of. An interesting article on this appears elsewhere in this journal.

With the object of encouraging and accelerating the pace of solar energy research, the University of Arizona and Stanford Research Institute sponsored the First World Symposium on Applied Solar Energy and the associated Conference on Solar Energy a few months ago. A fairly extensive report has appeared in *Science* (1956, 123, 826).

The World Symposium was attended by nearly a thousand scientists and engineers from thirty-two nations, and a permanent International Association for Applied Solar Energy has been organised. The first issue of the Association's news letter, *The Sun at Work*, has appeared in March while it is also planned to issue a *Journal of Solar Energy Research*, to report advances in solar sciences and engineering. The subjects of the papers at both meetings covered a wide range such as solar energy measurements, increasing the world's supply of energy (mechanical, electric and chemical) and increasing the world's supply of food (for both animal and human consumption).

### CONVERSION OF SOLAR ENERGY

Although many radiation-measuring stations exist in many countries, it is apparent that data about insolation are not readily available for large areas. The problems considered in the World Symposium included the type of

additional information that is most needed—the degree of measurement accuracy that is sufficient for most uses and the instruments that are required to perform these measurements correctly and simply enough to permit their widespread use throughout the world.

The conversion of solar energy into mechanical, electric, or even chemical energy was the main problem that engaged the attention of nearly everyone at the symposium. Physicists, physical chemists, engineers, and economists attacked the problem according to their own disciplines, and the industrialists and businessmen who had joined them attempted to evaluate and correlate the various approaches. The conversion processes considered were: (i) thermal conversion processes; (ii) electrical conversion processes; and (iii) photochemical processes.

#### THERMAL CONVERSION PROCESSES

In the solar energy field there are two schools of thought devoted respectively to the so-called flat-plate collectors and concentrators. The flat-plate collectors make use of the hot-house effect, absorbing the radiation on a dark surface and inhibiting reradiation loss by appropriate insulation and usually one or more parts of glass cover plates. So far, this has been used in hot-water installations, space-heating installations, and in mechanical pumps. The types of installations built in England, Japan and Israel were described during the Conference. These consist usually of a flat-plate collector (area from 30 to 60 square feet, depending on climate and consumption) connected to an insulated storage tank (50 to 100 gallons) that is located about 2 feet above the collector to permit thermosiphon flow of the heated water. These installations were described as economical and efficient. It appears that solar collectors with auxiliary conventional heat sources can supply all space-heating requirements of dwellings with adequate roof area in regions with average or better-than-average climates.

Another interesting use of flat-plate collectors is in mechanical pumps. The hundreds of Arizona farmers who visited the solar exhibit in Phoenix observed a simple Italian solar pump in action. Such was their interest that 50 of these pumps, manufactured by the Somor Company in Lecco, Italy, could have been sold on the spot if they had been available. This pump utilizes an ordinary flat-plate collector to vaporize sulfur dioxide which drives a sim-

ple, one-cylinder motor that is cooled by the pumped water. The pump converts solar energy into mechanical energy at about 4% efficiency.

In his paper on the "Economics of Solar Energy", J. Hobson estimated the cost of solar power to be, in optimum circumstances, between 4 and 8 annas per kilowatt hour. This figure reflects the high initial price of these devices and the low load factor under which they must operate with intermittent solar energy. However, even this is not expensive power where other fuels are not available and where man must depend on animal power or even his own power for his daily bread.

It may be possible to reduce the cost of flat-plate collectors appreciably in the near future, by using selective surfaces to obtain substantially high temperatures, than at present. These would strongly absorb the visible spectrum of sun's radiation, but at the same time emit very little of heat.

The term 'concentrator' is used to denote installations in which solar energy is concentrated in a small area by means of suitable reflectors. They have been used in many different ways. Small parabolic reflectors with an area of about one square metre have been shaped into solar cookers; large accurate parabolic reflectors are used as solar furnaces; cylindro-parabolic collectors have been used in steam-boiler installations, and finally, arrays of flat mirrors aimed at a single target can be used for many purposes.

Depending on the concentration ratio, temperatures can be reached all the way up to 3,500° C. If reasonable efficiencies are desired, it can be shown that flat-plate collectors are best used for temperatures up to 70° C. or 80° C., selective surface collectors up to 175° C., and concentrators from 100° C. to 3,500° C. The main disadvantage of concentrators is that the collector or an auxiliary mirror must track the sun, and the mechanism that is required to do this is usually expensive.

Much interest was shown in solar furnaces at the symposium. F. Trombe of the French National Centre for Scientific Research, reported on the work at the Mont Louis Laboratory in the Pyrenees, where a 35-foot furnace—the largest in the world—has been in operation for several years. There is no doubt that the solar furnace is a well-established high temperature research tool that permits operation free from contamination by flames, magnetic fields, and the like, at temperatures as high as 3,000° C. to 3,500° C. The French Centre also announced

that construction was beginning on a 1,000-kilowatt furnace (10 times larger than the one at Mont Louis) to be located in the Pyrenees not far from existing installations. This furnace will be used for the production of ceramic and metallurgical materials.

The most interesting report on steam generation was prepared by V. A. Baum of the heliotechnical laboratory of the U.S.S.R. Academy of Science. In his paper, Baum described the plans for a centralized 1,000-kilowatt solar power plant now on the drafting boards of his laboratory. This plant will be able to generate steam at 350° C. and 16 atmospheres pressure. It would consist of a central black body boiler on a 40-metre tower at the focus of 23 concentric rail-road tracks on which rail-road cars with flat mirrors would focus the sun's rays to the unique target. The mirrors would follow the apparent path of the sun by travelling during the day around the track. The target would also rotate slowly during the day to follow the sun. This plant would then produce steam for electric power generation and use low pressure steam to heat homes in winter and to cool them in summer with a refrigeration unit.

Interesting work with concentrators has also been done in India by K. N. Mathur and K. L. Khanna at the National Physical Laboratory, and by A. L. Gardner of the INSDOC. This centred mostly round hot-air engines, and Gardner has developed very simple and cheap concentrators consisting of arrays of flat mirrors aimed at a single target. Mention must also be made of the pioneering work in U.S.A. of Charles Abbott of the Smithsonian Institution, who has built, and is still building, small solar engines with specially designed flash boilers to permit rapid steam generation.

#### ELECTRIC CONVERSION PROCESSES

Much attention was devoted at the symposium to recent developments with photovoltaic cells for converting sunlight directly into electric energy. The Bell Telephone Laboratories have developed a converter which consists essentially of a silicon crystal with a small amount of arsenic impurity covered with a very thin layer of boron impurities (about  $10^{-4}$  in. deep). The crystal so prepared is about 1 in. in diameter and 0.04 in. thick. A number of such small crystals or wafers may be connected in series and assembled on a common backing; they convert solar energy into electricity at convenient direct-current voltages. These

cells are now being tested in operating telephone repeaters near Americus, Ga. A conversion efficiency of about 10% has been achieved.

A whole session of the symposium was devoted to thermocouples and thermoelectric generators. T. Momota (Tokyo) reported experiments with reduced titanium dioxide semiconductors in which efficiencies slightly in excess of 1% at 550° K. were obtained. From his results, he predicted that lead telluride might permit efficiencies as high as 16%. Further research in this field may ultimately yield a much cheaper collecting surface with, perhaps, lower efficiencies than the silicon converter mentioned above.

One paper by K. M. Sancier of Stanford Research Institute described the various types of photo-galvanic cells that have been known for years. His experience with certain of these cells indicated a conversion efficiency not far different from those attainable with thermocouples. It appears that further research in this field may prove profitable.

#### PHOTOCHEMICAL CONVERSION PROCESSES

Probably one of the two most promising attempts at converting solar energy to power is through the production of hydrogen by the photochemical breakdown of water under exposure to sunlight. Various organic and inorganic photocatalysts that will absorb sunlight and transmit the absorbed energy to a second reactant that will initiate the decomposition of water are used in most reactions. In the decomposition reaction, the photocatalyst and all other reagents are regenerated so that only water is consumed. From the papers presented it emerges that it is still too early to know whether such experiments will be completely successful; but if they are fairly high maximum efficiencies of the order of 30% to 40% could be expected.

#### INCREASING THE WORLD'S FOOD SUPPLY

The interest of the biologists and engineers centred round the problems of (i) increasing the world supply of fresh-water with solar stills to convert saline or brackish waters into fresh-water for domestic or agricultural uses, (ii) finding more efficient plant cultures to increase the world supply of food directly, and (iii) increasing the rate of growth of certain crops by using reflectors or other auxiliary heat collectors.



New developments in the field of solar stills were reported by American and Algerian researchers. They indicate that although solar stills cannot produce fresh-water at prices acceptable to large-scale consumers such as farms and large cities, there is no doubt that small stills can provide drinking water at reasonable prices in areas where none is available.

One of the most efficient plant cultures that has received considerable study in recent years is the algæ, *Chlorella*. Many papers were therefore devoted to its characteristics. While no one exactly agrees on the energy conversion efficiency of *Chlorella*, it appears that under favourable conditions, *Chlorella* will do better than most higher plants. *Chlorella* therefore may provide a technique for increasing the world's food supply and possibly even for producing fuels for use in conventional boilers. Unfortunately, to date no strain of *Chlorella* has been found that will grow profusely without somewhat complicated and costly equipment.

Papers by N. W. Pirie (Harpenden, England) and P. C. Mangelsdorf (Harvard University) stressed the merits of higher plants as storers of solar energy. Their contention was that if as much time, attention, and care were devoted

to certain higher plants as have been devoted to *Chlorella*, there is little doubt that increased growth efficiencies close to those demonstrated by some *Chlorella* strains would be obtained. Mangelsdorf pointed out that of approximately one-third million species of plants in the world, the world's people obtain the larger proportion of their food from approximately 12 species (potatoes, sweet potatoes, cassavas, cane, beets, rice, wheat, corn, soya beans, common beans, coconuts, and banana). The various types of plants mentioned (root plants, sugar plants, grains, beans, and trees) appeared to him a promising field for the study of hybridization.

It is probable that in the years to come the emphasis of research will be directed toward attempts at modifying the genetics of higher plants to increase, among other things, their protein productivity.

The symposium revealed that there are immense possibilities in the utilisation of solar energy, provided suitable converters are evolved. It also brought out the fact that the fundamental aspects of the techniques or such a conversion have been fairly well studied and that a concerted effort should now be made by scientists, engineers and industrialists to carry out research into the practical application of these methods.

#### DIAMOND AS A PINPOINT RADIATION COUNTER

SINCE van Heerden reported that silver chloride at low temperature would detect  $\beta$ -particles, several other crystals have been found which possess this property, and diamond is one of the most useful of them. Cotty (*Nature*, 1956, 177, 1075) has observed that certain types of diamond will act as ideal radiation counters at room temperature for  $\alpha$ - and  $\beta$ -sources usually used in the laboratory, and are as efficient as the Geiger counter.

Diamond has physical and chemical properties which makes it an attractive material for use in a practical counter. Physically, its density is such that diamond has a stopping power nearly three thousand times greater than that of air, and electronically, the density (and the  $\gamma$ -ray absorption) of carbon is of the same order as that of human tissue. Thus a high-speed particle would penetrate both diamond and tissue to about the same degree. Consequently, if the diamond counter were to be used to measure the dose-rate on patients receiving deep therapy or similar

treatment, one would expect to get more accurate measurements than could be obtained with more conventional instruments. Furthermore, because of its chemical composition, diamond can be autoclaved and sterilized satisfactorily for use internally.

The only drawback against the use of every diamond for the purpose appears to be polarization due to space charges built up inside which oppose the externally applied field and reduces its counting efficiency. This is due to current carriers being captured by the trapping sites in the crystal. But Cotty has been able to sort 100,000 diamonds (by ultraviolet fluorescence tests), which are electronically perfect enough not to be seriously affected by polarization. These diamonds, it is claimed, make really efficient counters and maintain a reasonably steady counting rate for periods of several hours, perhaps indefinitely. Such diamonds have been in use for the past five years and hold out possibilities of ultimately being developed into a useful pinpoint counter suitable for specialised—probably medical applications.

# CONTROLLABLE THERMONUCLEAR REACTIONS BY MEANS OF GAS DISCHARGES\*

**T**HEORETICAL and experimental work in atomic and nuclear physics has in recent years led to searches for new ways of utilizing atomic energy for peaceful purposes. Of these, special mention may be made of thermonuclear reactions, where the energy contained in the nucleus of the atom is emitted, not by the fission of heavy atomic nuclei of uranium or thorium, but as a result of deuterium or tritium, which are rare varieties of hydrogen. Deuterium is found in nature and can be extracted in large quantities from water by electrolysis. Tritium can be obtained in atomic reactors by bombarding lithium with neutrons.

In the hydrogen bomb it has been possible to create conditions for converting deuterium into helium. This is precisely a thermonuclear reaction. But in order to make it a controllable reaction it is necessary to find ways to ensure that it shall not be in the nature of a powerful and destructive explosion.

Thermonuclear reactions can arise only if the temperature of a substance is so high that when nuclei collide as a result of their thermal movement, there is a possibility of overcoming the mighty electrical forces of repulsion existing between the nuclei. The excitation of thermonuclear reactions in deuterium or in a mixture of deuterium and tritium is of particularly great interest, as in this case the temperature required to produce a noticeable effect is lower than when other substances are used. However, even in this most favorable case, in order to come even near the threshold of thermonuclear reactions, the temperature of the substance has to be raised to some millions of degrees. At that temperature, deuterium can exist only in the form of plasma—a medium composed of electrons and bare atomic nuclei divested of electron shields.

The amount of energy that must be concentrated in the plasma for its temperature to rise to heights at which thermonuclear reactions can become sufficiently intense is relatively small. At a temperature of a million degrees, the thermal energy accumulated in one gram of deuterium is only a few kilowatt-hours. Therefore, if a method were invented for heat-

ing the plasma so as to ensure the preservation of the accumulated thermal energy, it would then be possible to cause intensive thermonuclear reactions. The chief difficulty, however, is precisely that of precluding heat losses, which already at a temperature of some tens of thousands of degrees become so large that without thermal insulation a further rise of temperature becomes a practical impossibility.

When a very dense substance is heated, yet another serious obstacle arises. It is necessary to overcome in some way the enormous mechanical forces that arise owing to pressure increasing with temperature. In trying to heat solid or liquid deuterium, one finds that already at 100,000° C. the pressure exceeds a million atmosphere. Therefore, in a substance of high density a thermonuclear reaction can only be induced for a very brief space of time and such a process will be in the nature of a short pulsation or weak explosion. This makes it necessary to conduct experiments with gaseous deuterium.

But in heating deuterium, it is essential to prevent its particles, which assume high velocities, from dispersing on all sides, carrying the thermal energy to the walls of the vessel in which they are contained. For this, it is necessary to devise an experiment making it possible to retain the particles in the plasma, that is to say, to deprive them of the possibility of transmitting heat to the walls.

One idea that has arisen in connection with this problem is to use a magnetic field for thermal insulation of the plasma. This was first suggested in 1950 by Academician A. D. Sakharov and by Academician I. E. Tamm. They have shown that a magnetic field can play the part of an "invisible wall", restricting the plasma and creating thermal insulation. A magnetic field fundamentally changes the nature of the movement of the charged particles, i.e., electrons and nuclei, in the plasma. They cease to move in straight trajectories and begin to move in spirals with a small radius. Using a common figure of speech, it can be said that they are imprisoned in the plasma like a squirrel in a cage. Having lost its freedom of movement, the particle, if there is a

\* From an article in *Pravda* by Academician I. V. Kurchatov.

magnetic field, can no longer carry energy away from the plasma.

The magnetic field required for thermal insulation can be created by passing a sufficiently strong electric current—a current of some hundreds of thousands of amperes—through a rarefied gas. If an electric discharge more powerful than any lightning is created in the gas then, on the basis of theoretical considerations, it may be expected that the substance in the discharge chamber will for some millionths of a second be compressed into a thin plasmic cord severed from the walls of the chamber and heated to a very high temperature. If such a discharge takes place in deuterium, then, given a sufficiently strong current, we should observe the emission of neutrons produced as a result of the thermonuclear reaction.

On the basis of these considerations Soviet physicists organised experiments to study powerful electric discharges in gases. In these experiments they investigated phenomena arising when strong currents are passed through hydrogen, deuterium and other gases at various degrees of rarefaction. The peak current reached two million amperes, and the instantaneous energy released in such brief discharges in some of the experiments was more than ten times as great as the capacity of the Kubiyshev Hydro-Electric Station. For such experiments, however, it is not enough to have installations that make it possible to concentrate such vast energy. It is also necessary to have highly efficient apparatus of various kinds to record the development of processes in the plasma that last for some millionths of a second. High speed oscillographs, ultra-high-speed motion picture filming, cameras with electrically powered shutters, and electronic computers—all this complex arsenal of modern experimental physics was used in studying the properties of the plasma heated by an instantaneous impulse current.

Briefly, the experiments have shown that by passing a current of several hundred thousand amperes through a rarefied gas it is actually possible to heat the plasmic cord that is formed to a temperature of the order of a million

degrees centigrade. No one had previously succeeded in obtaining such a temperature in laboratory conditions. A higher temperature is achieved only in a hydrogen bomb. In that case, however, the investigator dare not risk coming within less than a few kilometres from the explosion. In the experiments reported here the thin streak of the heated plasma contained inside the discharge chamber is not dangerous because it consists of only a small amount of substance.

A result of these investigations that is no less interesting was the discovery in 1952, of the emission of neutrons and high energy X-rays from the discharge. True, the neutron emission in this case cannot be regarded as a result of thermonuclear reaction, since it is evidently conditioned in the main by some new and previously unknown processes in the plasma. It appears that the phenomena taking place in the plasma are very much more complex than the simplified picture produced in the initial theoretical constructions.

The facts obtained experimentally have upset many conventional conceptions about the properties of plasma, which gained currency as a result of many years of investigation of gaseous discharges in ordinary conditions. The plasma in the discharge chamber goes through rapid and successive compressions and expansions, during which the substance alternately converges on the centre of the discharge chamber and disperses to the walls with an enormous speed reaching 100 kilometres per second. In the process, very high electric potentials—which, perhaps, are one of the basic reasons for the appearance of neutrons and penetrating X-rays—form in the plasma for a short time.

Only further investigations will be able to provide an answer to the question whether it is possible by proceeding along this path to approach the creation of a controllable thermonuclear reaction of high intensity. At the same time, it is necessary to study other trends in solving this basic problem. Of considerable interest, in particular, is the study of the possibility of obtaining a thermonuclear reaction in continuous processes of long duration.

GLYCOLYTIC ENZYMES IN GREEN GRAM (*PHASEOLUS RADIATUS*)

K. V. GIRI AND T. RAMASARMA

Dept. of Biochemistry, Indian Institute of Science, Bangalore-3

DURING the past few years, considerable amount of literature has accumulated in favour of the view that the systems involved in the transformation of sugars in higher plants are strikingly similar to those found in yeast and animal tissues. The evidence for the existence of the well-known Embden-Mayerhof glycolytic pathway in plants and especially in peas has been summarised by Stumpf.<sup>1,2</sup> The importance of glycolytic cycle in the overall metabolism of plants will be appreciated only after the full documentation of the cycle in many plants. We discuss briefly the important findings made in our laboratory during the past few years on the glycolytic enzymes in green gram (*Phaseolus radiatus*) which constitutes the second important source in which all these enzymes have been identified, the first one being peas.

The two starch synthesising enzymes, phosphorylase and Q-enzyme, catalysing the following reactions have been identified in aqueous extracts of green gram seeds and their properties have been studied by Sri Ram and Giri.<sup>3</sup>

Glucose-1-phosphate  $\rightleftharpoons$  Amylose + Inorganic phosphate (Phosphorylase).

Amylose  $\rightarrow$  Amylopectin (Q-enzyme).

Phosphoglucumutase, the enzyme which brings about the equilibrium between glucose-1-phosphate and glucose-6-phosphate, has been studied in detail in green gram seed extracts by Ramasarma, Sri Ram and Giri.<sup>4</sup> Phosphoglucose isomerase which brings about equilibrium between glucose-6-phosphate and fructose-6-phosphate has been identified in green gram seeds and has been found to be distributed in every part of the plant-root, stem and leaves (Ramasarma and Giri<sup>5</sup>). The kinases which phosphorylate glucose, fructose, mannose, galactose and fructose-6-phosphate in presence of ATP have been demonstrated in green gram by Giri, Ramasarma and Nagabhushanam.<sup>6</sup> Fructose diphosphate was found to be split up into triose phosphates by aldolase of green gram and the triose phosphates were found to be oxidised in presence of diphosphopyridine nucleotide, by the combined action of triose phosphate isomerase and triose phosphate dehydrogenase present in green gram extracts. Phosphoglyceryl kinase has been identified in green gram by the Lipmann-Tuttle hydroxylamine method,

according to Axelrod and Bandurski.<sup>7</sup> Phosphoglyceromutase has been assumed to be present in peas based on the fact that 3-phosphoglyceric acid was transformed into pyruvic acid. We have been able to demonstrate this enzyme in green gram directly by the polarimetric method of Sutherland *et al.*<sup>8</sup> The reaction mixture consisted of approximately 250 micromoles of DL-2-phosphoglyceric acid (as potassium salt), 20 micromoles of sodium fluoride to inhibit the phosphatase action and 0.5 ml. of enzyme solution in a total volume of 1.5 ml. After 1 hour reaction at 37°, 0.5 ml. of 25% trichloroacetic acid was added to stop the reaction and the precipitated proteins were centrifuged and separated. The supernatant was neutralised and an appropriate aliquot was mixed with half volume of 25% ammonium molybdate and the optical rotation determined. Under the above conditions 26 micromoles of 3-phosphoglycerate was formed.

When 3- or 2-phosphoglyceric acid was incubated with green gram extract, an increase in pyruvic acid and inorganic phosphorus was observed as a result of the action of phosphatase hydrolysing phosphoenolpyruvic acid formed by enolase action. In the presence of added adenosine diphosphate, the pyruvic acid content increased indicating the presence of phosphopyruvic kinase. The reactions are presented below:

1, 3-diphosphoglyceric acid + ADP  $\rightleftharpoons$  3-phosphoglyceric acid + ATP (Phosphoglyceryl kinase).

3-phosphoglyceric acid  $\rightleftharpoons$  2-phosphoglyceric acid (Phosphoglyceromutase).

2-phosphoglyceric acid  $\rightleftharpoons$  Phosphoenolpyruvic acid + H<sub>2</sub>O (Enolase).

Phosphoenolpyruvic acid  $\rightarrow$  Pyruvic acid + Phosphate (Phosphatase).

Phosphoenolpyruvic acid Pyruvic acid

+  $\rightleftharpoons$  +

Adenosine diphosphate Adenosine triphosphate  
(Phosphopyruvickinase)

Carboxylase, which decarboxylates pyruvic acid and alcohol dehydrogenase which oxidises alcohol to acetaldehyde in presence of diphosphopyridine nucleotide were identified in green gram.

Despite the fact that the glycolytic cycle is functioning in green gram, the sugar transformations to pyruvic acid need not necessarily

involve this cycle exclusively. Preliminary investigations indicate the presence of the hexose monophosphate shunt pathway also in green gram. Partially dialysed extracts were able to oxidise glucose-6-phosphate in presence of TPN. Pentose was detected in the reaction mixture. It was also found that ribose-5-phosphate was isomerised to ribulose ester and the pentose phosphate further broke down to triose phosphates by green gram extracts.

Although the enzymes relating to the complete glycolytic system have been intensively studied in legumes, particularly peas and green gram, no such elaborate studies were made in the case of cereals and other plant tissues. In view of the importance of the cycle in plant, a thorough investigation of the distribution of the

various enzymes throughout the plant kingdom and through the different phases of life-cycle of plants and the different organs of the plants would reveal interesting facts about plant metabolism.

1. Stumpf, P. K., *Ann. Rev. Plant Physiol.*, 1952, **3**, 17.
2. —, In *Phosphorus Metabolism*, Johns Hopkins Press, Baltimore, 1952, **2**, p. 29.
3. Sri Ram, J. and Giri, K. V., *Arch. Biochem. and Biophys.*, 1952, **38**, 231.
4. Ramasarma, T., Sri Ram, J. and Giri, K. V., *Ibid.*, 1954, **53**, 167.
5. Ramasarma, T. and Giri, K. V., *Ibid.* (In press).
6. Giri, K. V., Ramasarma, T. and Nagabhushanam, A. N. (Unpublished data).
7. Axelrod, B. and Bandurski, R. S., *J. Biol. Chem.*, 1954, **204**, 939.
8. Sutherland, E. W., Posternak, T. and Cori, C. F., *Ibid.*, 1950, **179**, 501.

## OBITUARY

HARRY JAMES DEUEL, JR.

H. J. DEUEL, JR., was born in St. Paul, Minnesota, on October 15, 1897. After graduation from Carleton College, he served for three years as a Junior Chemist in the Office of Home Economics of the U.S. Department of Agriculture and here he developed his interest in nutrition which continued during the rest of his life. This interest in nutrition had further stimulation from Lafayette B. Mendel and his colleagues at Yale, where he took his Ph.D. in 1923 and from Graham Lusk at Cornell University Medical School. After spending five years at the latter place and one year at the University of Maryland he moved to the University of Southern California at Los Angeles in 1929 as Professor of Biochemistry. Twenty years later he was made the Dean of Graduate School there and he held this post till his death.

Deuel's interest in and contribution to science, though covering various aspects of biochemistry, were mostly centered round nutrition. His earlier interests were in the digestion and metabolism of carbohydrates, and later on he became more interested in the metabolism of lipids. It is in this latter field that he became an authority. Starting with studies on ketosis that come within the sphere of both carbohydrate and fat metabolism, he engaged himself in work on metabolism of carotenoids, vitamin A, cholesterol and essential fatty

acids. The depth and range of his knowledge can easily be judged by the two volumes on *The Lipids* published by him. It is a pity that death removed him before he could complete the third and final volume. His interest and enthusiasm for research are well testified by the fact that twice he used himself as a subject of study: once (while with Prof. Lusk) he maintained himself on a diet adequate in calories but practically free of protein for 63 days for protein metabolism studies in humans. The second time he used himself for ketosis studies in humans.

In December 1954, he developed osteogenic sarcoma and was obliged to undergo a hemipelvectomy, but on April 17, 1956, he succumbed to lung cancer. We had the proud privilege of associating with Harry Deuel and from our personal experience we can say that his kind heart, warmth of friendship and endless energy and enthusiasm will not be forgotten for a long time by anybody that has come in contact with him. He was not only a top nutritionist but he was a real human being.

Dept. of Biochemistry,  
Indian Institute of Science,  
Bangalore,  
and  
Dept. of Nutrition,  
Haffkine Institute,  
Bombay.

J. GANGULY.

S. M. PATEL.

## LETTERS TO THE EDITOR

	PAGE		PAGE
Dipole Moments of Ethylene Chloro and Bromohydrins—D. V. G. L. NARASIMHA RAO .. .. .	217	A Modified Hexabromide Test for the Detection of Linseed and Other Highly Unsaturated Oils in Mustard Oil—D. C. DEY, S. N. MITRA AND A. K. SANYAL ..	227
Ion Pair Ferric Oxalate as Initiator in Vinyl Polymerizations—R. V. SUBRAMANIAN AND M. SANTHAPPA .. .. .	218	On the Efferent Branchial Arteries of <i>Anabas testudineus</i> and Its Similarity with that of <i>Ophecephalus striatus</i> —DEVENDRA B. SAXENA .. .. .	227
Chromatographic Behaviour of Some Cations—T. H. V. SETTY .. .. .	218	Effect of $\gamma$ -(3 Indolyl)- <i>n</i> -Butyric Acid on the Leaf Movement of <i>Mimosa pudica</i> Linn. in Diffused Daylight and Artificial Light—SHRI RANJAN, A. K. DUTT AND B. MALAVIYA .. .. .	228
Behaviour of Illite on Repeated Salt Treatment and Desaturations—B. CHATTERJEE AND A. RAY .. .. .	220	Ethyl Malonate—An Inhibitor for Termitic Cellulase—J. N. MISRA AND P. K. VIJAYARAGHAVAN .. .. .	229
Isolation of a Steroid Fraction from Inflammatory Exudate—(MISS) S. R. DALAL .. .. .	220	Metabolic Meiotic Irregularities in <i>Cyclosorus repandulus</i> (v.A.v.R.) Ching.—G. PANIGRAHI .. .. .	230
Studies on the Histopathology of Nephrotic Kidney—SAILEN MOOKERJEE AND D. P. SADHU .. .. .	221	A Spontaneous Autotetraploid Gram ( <i>Cicer arietinum</i> L.)—NIRAD K. SEN AND MANAS K. JANA .. .. .	231
Amino Acid Make-up of Banana—H. N. BHAGAVAN AND R. RAJAGOPALAN .. .. .	223	On Two Species of <i>Riccia</i> New to Indian Flora—RAM UDAR .. .. .	232
CO., Evolution in Ensilage—R. VENKATAKRISHNAN AND V. MAHADEVAN .. .. .	223	A New Groundnut— <i>Arachis hypogaea</i> , Linn., var. <i>Oleifera forma erecta</i> , John et Seshadri ( <i>Forma nova.</i> )—C. M. JOHN AND C. R. SESHADRI .. .. .	233
Plasma $\alpha$ -Amino- <i>n</i> -Butyric Acid in Health and Disease—G. YEGNANARAYANA IYER .. .. .	224	An Eriophyid Mite on Sugarcane in South India—T. S. MUTHUKRISHNAN .. .. .	234
Occurrence of Apterous, Brachypterous and Macropterous Forms in <i>Haplothrips apicalis</i> Bagnall—T. N. ANANTHAKRISHNAN .. .. .	225		
Morphology of the Sucking-Pump of <i>Papilio demoleus</i> Linn. ( <i>Lepidoptera</i> )—K. P. SRIVASTAVA .. .. .	226		

## DIPOLE MOMENTS OF ETHYLENE CHLORO AND BROMOHYDRINS

THE dipole moments of ethylene chlorohydrin and ethylene bromohydrin are determined in solution in benzene at 30°C. using the method reported previously.<sup>1</sup> The values are also calculated following the method of Smyth<sup>2</sup> from the equation

$$\mu^2 = m_1^2 + m_2^2 + m_3^2 - 2m_1m_2\cos^2\phi + 2m_2m_3\cos\phi - 2m_1m_3\cos\alpha\cos^2\phi$$

where  $m_1$ ,  $m_2$ ,  $m_3$  are the moments of the C-Cl (or C-Br), C-O and the O-H bonds and  $\phi$ ,  $\alpha$  are the valency angles of carbon and oxygen respectively. It may be mentioned that in deriving the above equation Smyth has made the assumption that in rotation about the C-C bond all positions are equally probable for the dipoles. The values taken for these various parameters are:

$$m_1 = 1.9 \text{ (for C-Cl) and } 1.7 \text{ (for C-Br), } m_2 = 0.7, m_3 = 1.6 \text{ and } \alpha = \phi = 110^\circ.$$

For comparison, the results of Smyth<sup>2</sup> available for the chloro compound only are also shown in Table I.

TABLE I

Compound	$\mu$ calculated	$\mu$ observed
Ethylene Chlorohydrin	2.41 D	1.96
	2.41	1.89 (Smyth)
Ethylene Bromohydrin	2.26	2.18

Full details will be communicated shortly.  
Physics Dept., D. V. G. L. NARASIMHA RAO.  
Andhra University,  
Waltair, April 30, 1956.

1. Narasimha Rao, D. V. G. L., *Ind. J. Phys.*, 1956, 30, 91.
2. Smyth, C. P. and Walls, W. S., *J. Amer. Chem. Soc.*, 1932, 54, 2261

# ION PAIR FERRIC OXALATE AS INITIATOR IN VINYL POLYMERIZATIONS

THE ion pair complexes formed by ferric iron with hydroxyl, chloride, azide and citrate anions have been reported as photosensitizers for vinyl polymerizations in aqueous solution.<sup>1-3</sup> Ferric oxalate complex  $(\text{FeC}_2\text{O}_4)^+$  has been tried as an initiator and the results are reported here.

The conditions for the stability of the complexes of ferric iron with oxalic acid were studied spectrophotometrically by the method of variations.<sup>4</sup> It was found that in acid solutions ( $\text{pH} < 1$ ),  $(\text{FeC}_2\text{O}_4)^+$  was the only species formed according to the reaction



The equilibrium constants,  $4.13 \times 10^2$  and  $5.185 \times 10^2$ , for the above reaction at ionic strengths 0.5 and 0.2 respectively were determined. The extinction coefficients of the complex in the range 270 to 400  $\text{m}\mu$  have been plotted (Fig. 1).

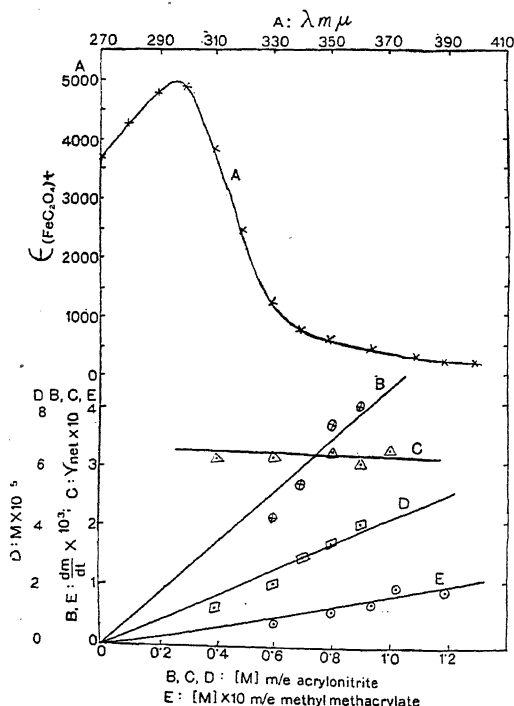


FIG. 1

Polymerisations were conducted at  $\text{pH} \sim 0.7$  where  $(\text{FeC}_2\text{O}_4)^+$  was the only active initiator, the concentration of  $(\text{FeOH}^{2+})$  being negligible. Irradiation with ultraviolet light ( $\lambda = 365 \text{ m}\mu$ ) of deaerated aqueous solutions of the system, monomer  $(\text{FeC}_2\text{O}_4)^+$  initiated polymerisation

almost immediately. Values obtained for the rates of monomer disappearance, chain lengths of the polymers, and the quantum yield ( $\gamma_{\text{net}}$ ) for ferrous ion production in the presence of methyl methacrylate are given in Table I.

TABLE I

$[\text{M}]$ m/l	$d\text{Fe}^{2+}/dt \times 10^5$ m./hr./80 c.c.	$\gamma_{\text{net}}$	$dm/dt \times 10^3$ m./hr./80 c.c.	$M \times 10^{-5}$
0.14	0.94	0.241	1.15	2.423
0.12	0.96	0.246	0.8	2.125
0.11	..	..	0.9	2.423
0.094	0.92	0.236	0.6	1.923
0.08	0.96	0.246	0.45	1.614
0.06	0.94	0.241	0.30	..

The linear variation of rates of monomer disappearance and chain length with monomer concentration,  $[\text{M}]$  (Fig. 1) indicate that initiation was by the oxalate radical ion  $\text{C}_2\text{O}_4^{\cdot-}$  and termination of polymerisation by recombination.  $\gamma_{\text{net}}$  slightly increased with increasing monomer concentration in the case of methyl acrylate, whereas with the other two monomers it was almost constant and independent of  $[\text{M}]$ . The maximum quantum yield with the oxalate complex was  $\sim 0.5$  and therefore much higher than the values obtained with the other initiators mentioned above.

Detailed results will be published elsewhere.

University Physical Chemistry Lab.,  
R. V. SUBRAMANIAN.  
M. SANTHAPPA.  
Madras-25, May 4, 1956.

1. Evans, M. G. and Uri, N., *Nature*, 1949, **164**, 404.
2. Evans, M. G., Santhappa, M. and Uri, N., *J. Poly. Sci.*, 1951, **7**, 243.
3. Subramanian, R. V. and Santhappa, M., *Curr. Sci.*, 1955, **24**, 229.
4. —, and —, *J. Madras Univ.*, 1956, **26B**, 63.

## CHROMATOGRAPHIC BEHAVIOUR OF SOME CATIONS

HORIZONTAL paper chromatography has gained much popularity as it has certain decided advantages over the vertical strip chromatography. Recently Murthy and co-workers<sup>1</sup> have adopted circular chromatography of Giri *et al.*<sup>2</sup> for the separation of inorganic radicals also. The present communication gives an account of the chromatographic behaviour of the following metals: Fe, Al, Cr, Zn, Mn, Ni, Co, U, V, Mo and Ti.

About 0.05 to 0.1 molar solution of either chloride or sulphate of the above metals were prepared. 0.05 ml. of each of the solutions was spotted at the centre of a 12 cm. filter disc

(Whatman No. 1) and irrigated for about 2 hours with a suitable solvent as described by Murthy and co-workers.<sup>1</sup> The chromatograms were identified by spraying with suitable reagents, as recommended by Feigl<sup>3</sup> and Vogel.<sup>4</sup> Several mixtures of the above metallic solutions were also tried and the  $R_f$  value of each metallic band was calculated. Iron, molybdenum and uranium developed blue, brown and reddish brown bands when sprayed with potassium ferrocyanide. Aluminium and zinc were identified as pale red bands by spraying with alizarin followed by ammonia. Hydrogen peroxide produced reddish brown and orange yellow bands with vanadium and titanium respectively. Nickel and cobalt complexes (rose red and brown) with dimethyl glyoxime, could be clearly identified after separation. Manganese develops dark grey band with ammoniacal silver nitrate. Chromium to be detected after oxidising with hydrogen peroxide and spraying with lead acetate.

Table I gives the  $R_f$  values of the metals when developed with different solutions.

TABLE I  
(Time of irrigation : 2 hours; Temp. 28-30° C.)

Solvent	Fe+++	Al+++	Cr+++	Zn++	Mn++	Ni++	Co++	Mo+++++	U++++	V+++++	Ti++++
I	1.0	0.6735	0.8923	0.6003	0.7144	0.5624	0.6552	0.982	0.944	0.82	0.7887
II	1.0	0.746	0.60	0.73	0.80	0.694	0.8458	0.9601	0.9419	0.8812	0.8019
III	1.0	0.5494	0.8078	0.7956	0.8061	0.7588	0.8058	0.9819	0.9618	0.7993	0.7422
IV	1.0	0.6561	0.6651	0.8917	0.6377	0.5565	0.6462	0.8896	0.7912	0.7066	0.6889
V	Slight movement	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
VI	Nil	Nil	Multiple spots	Nil	Nil	Multiple spots	Spreads all over	1.0	Nil	Nil	Multiple spots
I	Acetone 5% HCl 5% water			II	Acetone 10% HCl 5% water			III	Acetone 10% HCl 10% water		
IV	Alcohol 10% HCl			V	Acetone 5% Pyridine			VI	Water 5% Pyridine		

The results presented in Table I indicate a convenient method of separation of individual metals when they are present in a mixture. Fe, Al and Cr form a group from which each component can easily be resolved as the  $R_f$  values are considerably different. Actually it was found that acetone, 10% HCl, 10% water is the best resolving solvent. The  $R_f$  value of the individual metal in the mixture was in close agreement with  $R_f$  value obtained by running a chromatogram with only a single metal. This holds good practically in all cases. Fe, Zn, Mn, Ni and Co form another group of metals which can be resolved with the solvent, alcohol with 10% HCl. Other solvents do

separate but the segregation is not distinct as the  $R_f$  values with the solvents are close to each other. Fe, Mo, U, Ti and V form the third group tried for separation. Alcohol with 10% HCl develops the chromatogram distinctly. Although the other solvents resolve them, the bands are sometimes close and overlap.

Among the solvents tried, only solvents containing acid could separate effectively. In the alkaline medium, there is no or little movement of the metal although it is known that pyridine forms complexes with several metals. However, only molybdenum moves along with the solvent, getting an  $R_f$  value of 1. It was noticed in a few instances that "ghosts" and "multiple spots", were given with water pyridine system.

The behaviour of the metallic ions under different experimental conditions is under detailed study.

The author's grateful thanks are due to Dr. Vasudeva Murthy for the helpful discussion.

Dept. of Chemistry,  
First Grade College,  
Tumkur, May 4, 1956.

T. H. V. SETTY.

1. Murthy, A. R. V., Narayan, V. A. and Rao, M. R. A., *Curr. Sci.*, 1955, **24**, 158.
2. Giri, K. V., *et al.*, *Nature*, 1952, **169**, 923.
3. Feigl, F., *Spot Tests, Inorganic Applications*, 4th Ed., 1954, I. Elsevier's, New York.
4. Vogel, A. I., *A Text-Book of Qualitative Chemical Analysis*, Second Edn., New impression, 1952, Longmans, Green & Co., London.



### BEHAVIOUR OF ILLITE ON REPEATED SALT TREATMENT AND DESATURATIONS

IN continuation of our investigation<sup>1-5</sup> on the behaviour of pure clay minerals under repeated salt treatment and desaturations, estimations have been made of the amounts of  $Al^{+++}$  ions and the acid displaced from a hydrogen system prepared from the clay fraction isolated from a sample of illite after successive leaching with a normal solution of calcium chloride till no acidity or  $Al^{+++}$  ions could be detected in the leachate. The Ca-illite, i.e., the residue obtained after continued leaching with  $N CaCl_2$ , was converted into H-clay by treating with 0.02 N HCl followed by washing with distilled water, then leached repeatedly with  $N CaCl_2$  and the acidity and the amount of  $Al^{+++}$  ions present in the clear salt extract estimated in each leachate. The sequence of operations described above was repeated four times. The details of the experimental procedure used have been described previously.<sup>4</sup> The results are given in Table I.

ions and acid displaced by  $N CaCl_2$  from H-illite greatly decrease after the first desaturation. The data presented in this note in conjunction with those on H-montmorillonite and H-kaolinite reported previously<sup>4,5</sup> seem to indicate that H-illite occupies an intermediate position between H-montmorillonite and H-kaolinite so far as the decomposition of the clay-absorption-complex on repeated salt treatment and desaturations is concerned, H-montmorillonite suffering the most decomposition while the H-kaolinite the least.

Bengal Engineering College, B. CHATTERJEE.  
Howrah, West Bengal, A. RAY.  
April 17, 1956.

1. Mukherjee, J. N., Chatterjee, B. and Goswami, P. C., *J. Indian Chem. Soc.*, 1942, **19**, 405.
2. Mukherjee, J. N. and Chatterjee, B., *Nature*, 1945, **155**, 268.
3. Mukherjee, J. N., Chatterjee, B. and Banerjee, B. M., *J. Colloid Sci.*, 1947, **2**, 247.
4. Mukherjee, J. N., Chatterjee, B. and Ray, A., *Ibid.*, 1948, **3**, 437.
5. Chatterjee, B., *J. Indian Chem. Soc.*, Ind. and News, 1949, **12**, 81.

TABLE I

The amount of acid and  $Al^{+++}$  ions displaced from H-illite on repeated leaching with  $N CaCl_2$  and desaturations

Acidity and  $Al^{+++}$  ions in leachates, milliequivalents per 100 g. illite

Serial No. of desaturations	Serial No. of leachings with $N CaCl_2$								Total amount displaced	
	1st		2nd		3rd		4th		Acid	$Al^{+++}$
	Acid	$Al^{+++}$	Acid	$Al^{+++}$	Acid	$Al^{+++}$	Acid	$Al^{+++}$		
1st	..	63.0	4.0	5.0	Nil	2.5	..	Nil	70.5	4.0
2nd	..	16.0	1.0	1.0	Nil	..	..	..	17.0	1.0
3rd	..	0.5	Nil	Nil	..	..	..	..	0.5	Nil
4th	..	Nil	Nil	..	..	..	..	..	Nil	Nil

With successive desaturations the total amount of displaced acid decreases with the progress of leaching and finally attains a negligible value. The amount of  $Al^{+++}$  ions displaced on the addition of  $N CaCl_2$  decreases with the progress of leaching until practically no  $Al^{+++}$  ions could be detected in the leachate, indicating that there is a limit to the amount of  $Al^{+++}$  ions which can be displaced by repeated leaching of H-illite with  $N CaCl_2$ .  $Al^{+++}$  ions are, however, again displaced when the Ca-illite is rendered desaturated and treated with  $N CaCl_2$ . The total amounts of  $Al^{+++}$

### ISOLATION OF A STEROID FRACTION FROM INFLAMMATORY EXUDATE

INFLAMMATORY exudate formed in response to croton oil irritation in rats was subjected to chemical separation. This was undertaken in an attempt to screen the exudate for the presence of factor(s) having an influence on the course of inflammatory reaction. Since steroid hormones are known to modify inflammatory reactions in the body,<sup>1</sup> this investigation was restricted to the isolation of any active steroids.

The exudate (52 c.c.) was collected from 6 rats on the sixth day of the inflammation and was thoroughly extracted successively with

petroleum ether (40-60°), benzene and sulphuric ether. Each extract was washed with water, dried over anhydrous sodium sulphate and concentrated.

The residue from petroleum ether was 0.8 g. This was found actually to enhance inflammatory reaction and also gave negative reaction with Salkowski and Liebermann Burchard reactions.

The residual solvent-treated exudate was ether extracts were 0.2 g. and 0.1 g. respectively. Both these residues had no influence on the course of inflammation and gave negative tests with steroidal reagents.

The residual solvent-treated exudate was then refluxed with alcoholic potash (10%; 100 c.c. for 4 hours). The unsaponifiable matter (0.01 g.) was found to be embedded with colourless needles which gave a transient change of colour from green through blue and reddish violet to brown in the Liebermann test. In the Salkowski test reddish violet colouration in both the layers was obtained. It was found to be anti-inflammatory.<sup>2</sup>

Further work on the characterisation of this steroid fraction is in progress. It is obvious that the steroid obtained is in a combined state in the inflammatory exudate.

The exudate was kindly made available by Dr. T. H. Rindani who also studied the influence on inflammation of different fractions. Dept. of Organic Chem., (Miss) S. R. DALAL, Institute of Science, Bombay-1, May 23, 1956.

1. Taubenhans, M., *Ann. N. Y. Acad. Sci.*, 1953, 56, 623.

2. Rindani, T. H., 1956 (In press).

## STUDIES ON THE HISTOPATHOLOGY OF NEPHROTIC KIDNEY

STUDIES of the causal mechanism of hypercholesterolemia and hyperlipemia in nephrosis have been facilitated by the observation of Heymann<sup>1</sup> that the chronic renal disease, lipemia and edema produced in rats by injection of rabbit anti-kidney serum closely resembles the nephrotic state as it occurs in human.

The present communication confirms the suitability of Heymann's method and also describes the histopathological changes in kidney caused by the production of experimental nephrosis. The study on the mechanism of cholesterol synthesis in nephrosis showing great rise of cholesterol in blood and kidney

and depression of acetate, acetoacetate and succinate oxidation in kidney slices have been presented elsewhere.<sup>2</sup>

Antisera against rat kidneys were prepared by injecting suspensions of perfused rat kidney into rabbits. For perfusing the kidney, 0.9% NaCl solution was run into thoracic aorta at a hydrostatic pressure of 1 m. until the kidneys were grossly free from blood. The kidneys were then removed, weighed and 0.9% NaCl solution was added to make a 50% of suspension in a waring blender. About 25 ml. of suspension was prepared from the kidneys of 10 rats. After adding toluene and penicillin, 1,000 units/ml., the suspension was placed in an incubator at 37° C. for 24 hours.

Then the suspensions were stored frozen. Two rabbits weighing about 2,000 g. were given intraperitoneal injections of 8 ml. of a 10%, 15% and 20% suspension every other day for the first week. Twenty per cent. suspensions were injected for the second and third weeks. Six days after the last injection, 10-15 ml. of blood was obtained by cardiac puncture. More blood was obtained after 1-2 weeks' rest, 2-3 times in the same rabbits. The rabbit serum was then heated to 56° C. for half an hour to diminish primary toxicity. It was then stored frozen.

Nephrotoxic sera thus prepared was intravenously injected to 16 rats of 125-150 g. weight according to the dose of 1.4 ml./100 g. body weight. One-third of the dose was given by intravenous injection on each of the three consecutive days. Dramatic development of nephrosis was observed by the detection of albuminuria within 3-5 days of the injection. Four of the rats died probably due to overdose.

For histopathological study of kidney, 10% formalin was used as fixative and the section of 3-4  $\mu$  thickness were stained with hæmatoxylin and eosin. Photomicrographs of control and nephrotic kidney sections were taken. Comparison of the nephrotic kidney section with the control ones revealed the characteristic hydropic degenerative changes of the cortical tubules with more or less extended necrosis of the proximal convoluted tubules and presence of hyaline casts in the collective tubules of both cortex and medulla (Figs. 1 and 2). Many of the glomeruli also showed degeneration, distended capsular spaces and swelling of capillary walls (Fig. 2). Changes have also been presented in low power photomicrograph (Fig. 3).

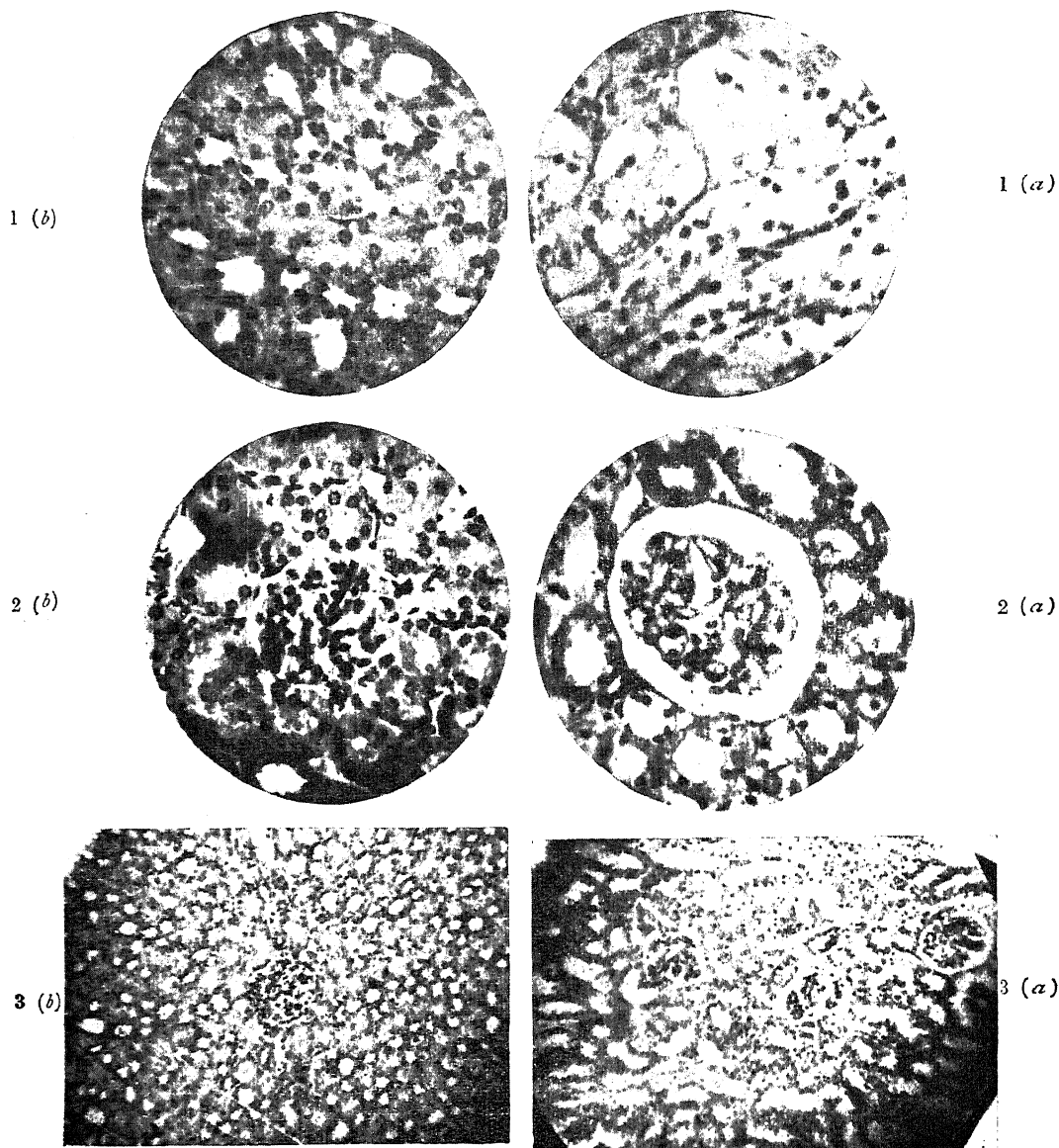


FIG. 1. (a) Hydropic degenerative changes of the cortical tubules. Compared with (b) Control. Photomicrograph,  $\times 400$ .

FIG. 2. (a) Degeneration of glomeruli, distention of capsular spaces and swelling of capillary walls. Compared with (b) Control. Photomicrograph,  $\times 400$ .

FIG. 3. (a) Similar changes in low power photomicrography,  $\times 100$ . Compared with (b) Control.

All tissues are fixed in formol and stained by Haematoxylin and eosin.

The authors wish to express their gratitude to Prof. M. C. Nath for his kind encouragement and to Mr. S. G. Nayudu for his help in photomicrography.

Dept. of Biochemistry, SAIEN MOOKERJEA.  
Nagpur University, Nagpur,  
and

Dept. of Physiology, D. P. SADHU.  
Bengal Veterinary College,  
Calcutta, December 20, 1955.

1. Heymann, W., *Methods in Medical Research*, 1952, 5, 264
2. Sadhu, D. P. and Mookerjee, S., *Metabolism, Clin. and Exptl.*, U.S.A., 1955, 6, 531.

## AMINO ACID MAKE-UP OF BANANA

BANANA is a good source of ascorbic acid,<sup>1,2</sup> and besides it contains thiamine,<sup>3</sup> riboflavin,<sup>4</sup> niacin,<sup>5</sup> folic acid,<sup>6</sup> silver<sup>7</sup> and iron.<sup>8</sup> The sugars in banana have been studied.<sup>9</sup>

The technological and allied aspects of banana have been worked out in great detail.<sup>10</sup> But very little information is available regarding the amino acid composition and nutritive value of banana proteins. In view of banana being consumed extensively and its importance as a foodstuff, data on the above aspects would be useful. This communication deals with the amino acid make-up of banana.

Three local varieties, *Pacha bale* (P), *Musa cavandishii* Lamb. var., *Rasa bale* (R), *Musa sapientum* Linn. var., and *Kada bale* (K), *Musa balbisiana* colla, were taken up for the study. About 50 g. of each variety was separately hydrolysed in the usual manner with 6N HCl. The hydrolysates were freed of excess acid by repeated evaporation on a water-bath and their total nitrogen contents were determined. The volumes of these hydrolysates were then made up such that equal volumes represented equal nitrogen contents. The circular paper chromatographic technique<sup>11,12</sup> was employed for investigating the amino acid make-up. The results are given in Table I.

TABLE I  
Amino acids in banana  
(Calculated to 16 g. nitrogen)

Amino acids	P	K	R	Reported values for casein <sup>13</sup>
Cystine	.. 1.7	1.4	2.3	0.3
Lysine	.. 5.8	6.5	6.6	6.0
Histidine	.. 8.3	10.3	7.1	2.5
Arginine	.. 6.1	5.1	5.3	3.8
Serine, glycine and Aspartic acid	12.9	13.8	15.6	9.6
Threonine and Glutamic acid	15.4	14.8	17.4	25.4
Alanine	.. 5.6	6.1	6.8	1.9
$\gamma$ -Amino butyric acid	.. 4.3	5.2	6.2	..
Tyrosine	.. 8.5	5.3	6.3	6.6
Methionine and Valine	.. 6.8	10.7	10.6	11.3
Phenylalanine	.. 2.4	3.7	4.8	3.9
Leucine and Isoleucine	.. 6.7	10.3	9.0	9.7

Although the total protein in banana is low, the quality of the protein appears to be quite satisfactory. It may be seen that all the amino acids in banana, except threonine-glutamic acid, are either equal to or higher than those

in casein. It is of interest to note that cystine, the sulphur amino acid, is present in higher concentration in banana. Varietal differences do exist, but not to an appreciable extent. The results suggest that banana proteins could form an useful supplement to a poor diet.

Supplementary value of banana proteins to poor South Indian diet and other aspects are being studied.

Our thanks are due to Prof. K. V. Giri for his keen interest in the investigation.

Dept. of Biochemistry, H. N. BHAGAVAN.  
Indian Institute of Science, R. RAJAGOPALAN.  
Bangalore-3, April 6, 1956.

1. Inderjit Babber, *Indian J. Med. Res.*, 1950, **38**, 263.
2. Storvick, C. A., Davey, B. L., Nitchals, R. M. and Coffey, R. E., *Food Res.*, 1950, **15**, 373.
3. de Moura Campos, F. A., *Brasil med.*, 1946, **61**, 197.
4. Waldron, R. J. and Fries, J. H., *Arch. Pediat.*, 1952, **69**, 205.
5. French, R. B., Abbot, O. D. and Tounsend, R. O., *Florida Agric. Expt. Sta. Bull.*, No. 482, 1951, 5.
6. Olson, G. E., Burris, R. H. and Elvehjem, C. A., *J. Amer. Dietetic Assoc.*, 1947, **23**, 200.
7. Ruiz, A. S., Guelbenzu, M. D. and Lopez de Azcona, J. M., *Anales fis y quim.*, 1946, **42**, 508.
8. Alvora Iregui Borda, *Rev. Colombiana quim.*, 1951, **4**, 32.
9. Lulla, B. S. and Johar, D. S., *Curr. Sci.*, 1955, **24**, 92.
10. Harry W. Von Loesecke, *Bananas—Chemistry, Physiology and Technology*, 1949, Interscience Publishers, Inc.
11. Giri, K. V., *Curr. Sci.*, 1951, **20**, 295.
12. —, Radhakrishnan, A. N. and Vaidyanathan, C. S., *Anal. Chem.*, 1952, **24**, 1677.
13. Philip H. Mitchell, *A Text-Book of Biochemistry*, 1946, McGraw Hill Book Company, Inc.

CO<sub>2</sub> EVOLUTION IN ENSILAGE

NAPIER GRASS, 4-5' high in 55 days growth, cut into pieces 2" long, was ensiled in laboratory silos with three different preservatives, cane sugar (jaggery or molasses) cane sugar and salt, and trichloroacetic acid separately in the same amount of water to resemble as far as possible the conditions present in pit silos in the tropical climate. The glass silos were packed in sawdust about 2" thick, in a cardboard box to minimise the sudden effect of external temperature. The daily variation of temperatures in the silos and external atmosphere were recorded. The CO<sub>2</sub> evolved, after washing and drying, was estimated by absorption in KOH solution, for a period of 20 days, when the gas production was minimum or nil. After 150 days of storage all the samples were found to be fine fruity or estery olive green silages,

highly palatable to animals. The data are summarised in Table I and  $\text{CO}_2$  evolution is represented graphically in Fig. 1.

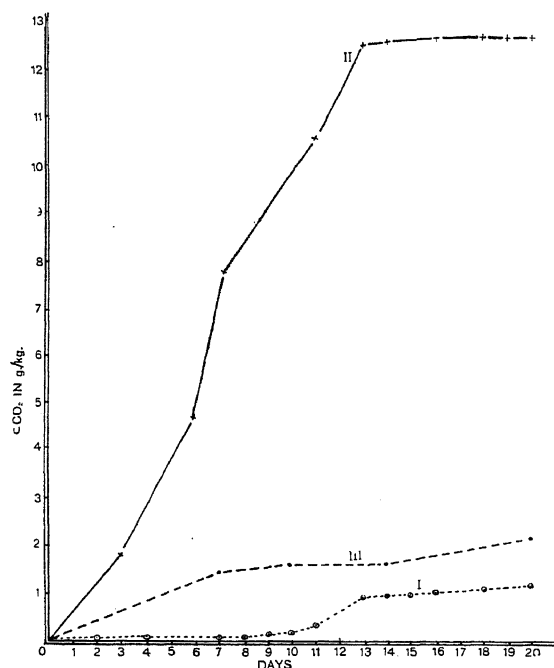


FIG. 1.  $\text{CO}_2$  in Lab. silos with preservatives.

I: Sugar and salt; II: Sugar; III: Trichloroacetic acid.

TABLE I

$\text{CO}_2$  evolved in Napier grass Lab. Silo during 20 days with variation of temperature

S. No.	Preservative per kg. fresh grass	Water with preservative to 1 kg. of fresh grass in c.c.	Min. temp. in Silo °C.	Max. temp. in Silo °C.	Diff. in temp. °C.	$\text{CO}_2$ /kg. in g.	Max. temp. outside °C.	Min. temp. outside °C.
1	20 g. sugar + 8 g. salt	400	27.5	31.5	4	1.1820	35.10	22.33
2	20 g. sugar	400	27	33	6	12.1728	29.55	18.44
3	0.09 g. trichloroacetic acid	400	24	29	5	2.1728	28.33	19.33

The cane sugar addition in ensiling Napier grass produced the highest temperature and the largest amount of  $\text{CO}_2$ , nearly ten times as large as that in the silage made with cane sugar and salt. Cane sugar recommended at 2% level,<sup>2</sup> and salt together had reduced the

quantity of  $\text{CO}_2$  to a minimum and also the temperature difference to the lowest which were both desirable in making good silage.

Though salt by itself had been found to be of no great value in silage making,<sup>5</sup> the addition of salt to cane sugar in our experiment controlled both the  $\text{CO}_2$  production and temperature rise to a minimum. Sugar improved the palatability of silage and its solution soaking the grass, had been reported to influence favourably the ensilage.<sup>3</sup> The new preservative, trichloroacetic acid, required in very small amount, had produced low amount of  $\text{CO}_2$  and low temperature rise, although the variations in both  $\text{CO}_2$  and temperature were higher than those in sugar and salt silage. Though all the three preservatives had produced "Low Fermentation" silages,<sup>1</sup> the salt with sugar added to Napier grass in ensiling under our laboratory conditions, appeared to be superior to sugar alone or trichloroacetic acid in the lowest production of  $\text{CO}_2$  having no effect on silage,<sup>4</sup> with minimum rise of temperature and without lowering the quality.

R. VENKATAKRISHNAN.

Nutrition Laboratory, V. MAHADEVAN.  
Madras Veterinary College,  
Madras-7, February 15, 1956.

1. Barnett, A. J. G., *Silage Fermentation*, Butterworth Publ., 1954, p. 9.
2. De Ruyter de Wildt, J. C., *Vers, Vereen, Exploit. Proefzuivelboerderis, Hoorn*, 1940, 123.
3. Dijkstra, N. D., *Emp. J. Expt. Agric.*, 1948, **16**, 231.
4. —, *Versl. Rijkslandb. Proefst's Graw*, 1951, No. 57, 10.
5. Wilson, J. K., *J. Amer. Soc. Agronom.*, 1948, **40**, 190.

### PLASMA $\alpha$ -AMINO-*n*-BUTYRIC ACID IN HEALTH AND DISEASE

THE detection<sup>1</sup> and estimation<sup>2,3</sup> of ( $\alpha$ ABA) in normal human plasma have been previously carried out. But for the reported occurrence<sup>4</sup> of abnormal amounts of  $\alpha$ ABA in the plasma of one patient in deep hepatic coma, little is known regarding the plasma levels of this amino acid in pathological conditions. In the course of the author's investigations on plasma amino acids in health and disease, using paper chromatography,<sup>5</sup> elevated levels of  $\alpha$ ABA have been found in certain diseases and the results are summarised in the histograms shown in Fig. 1. The following conclusions have been drawn:

(i) The elevation of plasma  $\alpha$ ABA is a fairly common observation in liver disease, (ii) it is

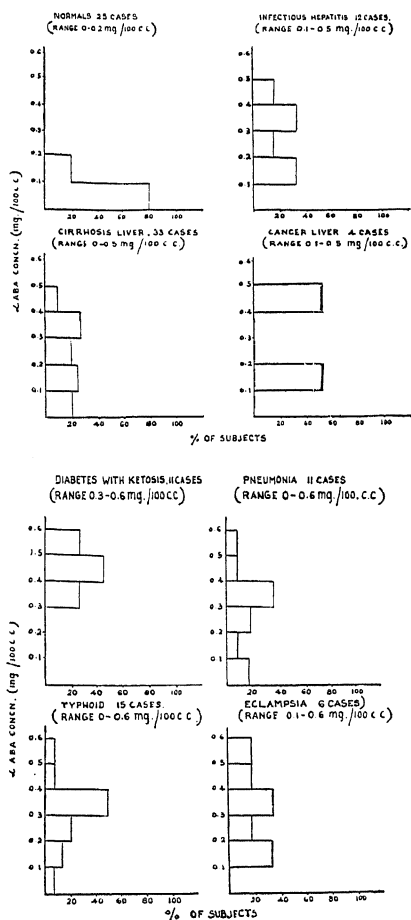


FIG. 1

not confined to patients in hepatic coma (only three cases among the 49 patients studied were in hepatic coma), and (iii) the same abnormality is manifested in cases of typhoid, pneumonia, diabetic ketosis and eclampsia.

Details will be published elsewhere.

The author's thanks are due to Dr. M. Sukumaran for his keen interest and to the Principal for facilities kindly provided.

Medical College, G. YEGNANARAYANA IYER.  
Trivandrum-4,  
April 5, 1956.

1. Dent, C. E., *Biochem. J.*, 1947, **41**, 240.
2. Eny, D. M. and Qualls, D. M., *Amer. J. Trop. Med. and Hyg.*, 1952, **1**, 220.
3. Stein, W. H. and Moore, S., *J. Biol. Chem.*, 1954, **211**, 915.
4. Chung Wu, Bollman, J. L. and Butt, H. R., *J. Clin. Invest.*, 1955, **34**, 845.
5. Iyer, G. Y. N., *Indian J. Med. Res.*, 1955, **43**, 189.

## OCCURRENCE OF APTEROUS, BRACHYPTEROUS AND MACROPTEROUS FORMS IN *HAPLOTHIRIPS APICALIS* BAGNALL

BAGNALL<sup>1</sup> first described *Haplothrips apicalis* as *Hindsiana apicalis* based only on apterous females. Priesner<sup>2</sup> (1935) in his studies on Indo-malaysian *Haplothrips* retained *apicalis* under *Haplothrips* and recorded macropterous and brachypterous forms from Java. In spite of the occurrence of apterous, brachypterous and macropterous forms, the question of the predominance of these characters in the species, has not been examined in detail. Recently as a result of extensive collections of this species from *Cyanodon dactylon* in Madras, it has been observed that apterous and brachypterous conditions are more predominant, macropterism being rather rare.

In small samples macropterous forms are frequently absent there being only brachypterous and apterous forms, while in a large sample comprising 204 individuals, 48% were apterous, 46% brachypterous and 6% macropterous, as shown in Table I. The brachypterous forms fall conveniently into 12 distinct groups (with respect of forewing length) each with a variation coefficient of  $14\mu$  or 0.014 mm. The macropterous forms have a forewing length range of 0.560 to 0.700 mm.

TABLE I  
Forewing length frequencies of a sample of 204 individuals

Wing groups	No. of females	No. of males	Total No.
Apterous	75	23	98
0.126	2	1	3
0.140	2	4	6
0.154	3	5	8
0.168	3	10	13
0.182	8	6	14
0.196	4	2	6
0.210	12	3	15
0.224	8	2	10
0.238	7	3	10
0.252	3	0	3
0.266	1	1	2
0.280	3	1	4
0.560	0	2	2
0.616	0	1	1
0.644	0	1	1
0.672	1	0	1
0.682	1	0	1
0.700	4	2	6

It has been possible to estimate the number of population groups based on body length, which

exhibit great variation (Fig. 1). In the above sample of 204 individuals there were 127 females and 67 males giving a sex-ratio of 2:1, the females ranging from 1.526 to 2.338 mm., while the males range from 1.232 to 1.932 mm., the average length of 137 females being 1.914 mm. and of males being 1.427 mm.

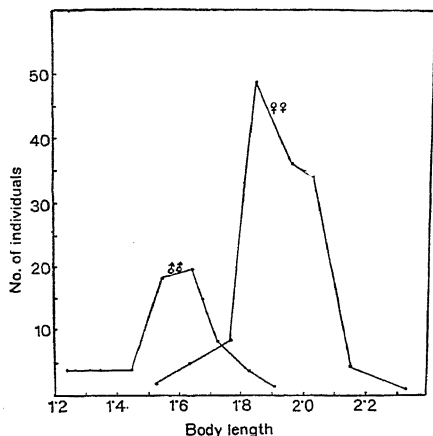


FIG. 1. Graph showing population groups based on body length.

The details regarding differential characters like wing length frequencies, body length and H.L./P.L. (head length/prothoracic length) ratio, are being published elsewhere, along with descriptions of immature stages and the significance of the occurrence of apterous, brachypterous and macropterous forms.

Dept. of Zoology, T. N. ANANTHAKRISHNAN.  
Loyola College,  
Madras-31,  
March 7, 1956.

1. Bagnall, R. S., *Ann. Mag. Nat. Hist.*, 1915, 15 (8).
2. Priesner, H., *Rec. Ind. Mus.*, 1933, 25, 358.

### MORPHOLOGY OF THE SUCKING-PUMP OF *PAPILIO DEMOLEUS* LINN. (LEPIDOPTERA)

THE exact structure of the sucking-pump of butterflies has not been described so far. Short,<sup>1</sup> while studying the muscles of this structure, maintains that it is not possible to ascertain the precise contribution towards its formation by the stomodæum and the cibarium. My studies of the head of *P. demoleus*, however, reveal that its sucking-pump is distinctly divisible into two regions: (i) an anterior pre-oral part or cibarium, and (ii) a large poste-

rior stomadæal part including the buccal cavity and the pharynx (Fig. 1). The cibarium is

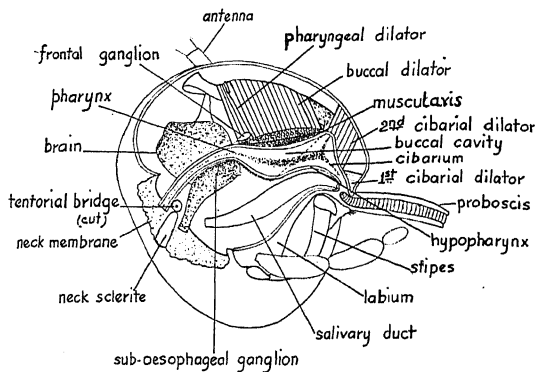


FIG. 1. Sagittal section of the head of *P. demoleus* (Semi-diagrammatic).

that portion of the sucking-pump on which two anterior dilators are inserted. The unpaired first anterior dilator (compressor of Snodgrass<sup>2</sup>) originates from the clypeal region and is inserted on the anterior part of the cibarium. The paired second anterior dilator also originates from the clypeal region to be inserted on the posterior part of the cibarium and demarcating the posterior limit of cibarium. The roof of this cibarial part of the sucking-pump is formed by the membranous clypeo-labral epipharynx and the floor by the sclerotized hypopharynx, flanked on each side by a suspensorial sclerite. The salivary duct also has its usual opening at the junction of the labium and the hypopharynx. The portion of the sucking-pump behind the second dilator should be considered the stomodæal part, because it is on this part that the frontal ganglion lies. Further, all parts of the alimentary canal are usually invested in a muscular sheath or *muscularis*. In this case, the muscularis stops short behind the second cibarial dilators and also does not cover that portion of the sucking-pump which is occupied by the hypopharynx. These features by themselves are indicative of the fact that the portion ensheathed by the muscularis is the stomodæal part and the portion not ensheathed by it is the cibarial part of the sucking-pump. According to Snodgrass's definition,<sup>2</sup> the part behind the frontal ganglion is the pharynx. Therefore, the part anterior to the ganglion but posterior to the second cibarial dilators should be regarded as the buccal region. The buccal region gives insertion to a pair of huge buccal dilators wrongly named by Short<sup>1</sup> as the cibarial dilators and the pharynx gives insertion to a pair of pharyngeal dilators.

My thanks are due to Dr. R. Rakshpal for his valuable guidance.

Dept. of Zoology, K. P. SRIVASTAVA.  
The University, Lucknow,  
February 24, 1956.

1. Short, J. R. T., *Proc. Roy. Ent. Soc.*, London, 1951, 27, 77.
2. Snodgrass, R. E., *Principles of Insect Morphology*, 1935, McGraw-Hill, New York and London.

### A MODIFIED HEXABROMIDE TEST FOR THE DETECTION OF LINSEED AND OTHER HIGHLY UNSATURATED OILS IN MUSTARD OIL

IN the well-known hexabromide test<sup>1,2</sup> widely recommended for the detection of linseed and other highly unsaturated oils in other oils and fats, acetic acid is used along with bromine and sulphuric ether. It has been found that the manner of stirring while adding bromine is of particular importance, as consistent results are not always obtained if the stirring is not uniform particularly so in the presence of small amounts of linseed oil. Also, very small amounts of linseed oil (say, about 2%) may escape detection by the above method. The hexabromide test as described by Cox<sup>3</sup> too fails to detect such small amounts of linseed. In this method also acetic acid is used along with bromine and nitrobenzene. In the authors' present method, acetic acid is omitted, and chloroform and rectified spirit have been used along with bromine and sulphuric ether. A somewhat similar combination, i.e., carbon tetrachloride and absolute alcohol, has been reported to be used by Procter.<sup>4</sup> Williams<sup>5</sup> has also described a somewhat similar method. The authors' modified method has the following advantages: (a) vigorous or continuous stirring or shaking at any stage of the procedure is not necessary; (b) as low as 2% (or even less) of linseed could be detected with certainty; and (c) the whole method takes much shorter time.

**The Test.**—To 1 ml. of the oil in a dry test-tube, add 5 ml. of chloroform. Add bromine dropwise until the mixture becomes deep red in colour (about 1 ml. of bromine is usually required) and cool the test-tube a little in iced water. Add rectified spirit dropwise while shaking the mixture until the precipitate which first forms just dissolves (when the amount of linseed oil present is large, the precipitate does not dissolve completely); in general, 1.3 to 1.5 ml. of rectified spirit is usually required. Then, add 10 ml. of sulphuric ether, mix and

place the tube in iced water for half-an-hour. Pure mustard oil remains absolutely clear, whereas presence of even 2% of linseed oil gives almost instant turbidity, and enough flocculent precipitate forms in about half-an-hour which settles at the bottom.

Genuine cocoanut, mohua, groundnut, safflower and nigerseed oils remain clear when subjected to the above test. Linseed, cod liver and fish oils give a very heavy precipitate.

By the above procedure, the presence of even less than 2% of linseed in mustard oil could be detected, but we may be satisfied if 2% of linseed oil can be detected with certainty.

West Bengal Public

D. C. DEY.

Health Lab.,

S. N. MITRA.

School of Tropical Medicine,

A. K. SANYAL.

Calcutta-12, January 27, 1956.

1. Sutcliffe, J. A. L., quoted by Elsdon, G. D., *The Chemistry and Examination of Edible Oils and Fats*, Ernest Benn Ltd., London, 1926, p. 131.
2. Gemmell, *Analyst*, 1914, 39, 297.
3. Cox, H. E., *The Chemical Analysis of Foods*, 1946, Churchill, London, 3rd Ed., 293.
4. Procter H. R., quote! by Elsdon, G. D., *Cf. Ref.* 1, p. 129.
5. Williams, *Oils, Fats and Fatty Foods, Their Practical Examination*, 1950, 3rd Ed., Churchill, London, p. 117.

### ON THE EFFERENT BRANCHIAL ARTERIES OF ANABAS TESTUDINEUS AND ITS SIMILARITY WITH THAT OF OPHICEPHALUS STRIATUS

RIDEWOOD<sup>1</sup> during his extensive studies on the blood vessels of teleostean fishes divided the efferent branchial arteries into four main groups according to their relation with the circulus cephalicus. All the four pairs of efferent arteries communicate directly or indirectly with the dorsal aorta. Later Lele,<sup>2</sup> Wu and Chang<sup>3</sup> and Das and Saxena<sup>4</sup> showed in different species of *Ophicephalus* that first and second pairs of efferent branchial arteries do not communicate directly or indirectly with the dorsal aorta, as they break up into capillaries to supply the lining membrane of the supra-branchial cavity used for aerial respiration. Such an arrangement of efferent arteries is not mentioned anywhere by Ridewood.

While working on the efferent branchial arteries of *Anabas testudineus* Bloch. (Perciformes; Anabantoidei; Anabantidae) I found a similar arrangement as met within *O. striatus*. In each gill-arch there is a pair of efferent branchial arteries situated on both sides of the



afferent artery on the ventral side of the ceratobranchial. The two efferent arteries of each gill-arch unite at the lateral tip of the ceratobranchial into one efferent branchial artery. Each efferent branchial artery leaves at the postero-dorsal end of a gill-bearing arch. The first pair of efferent branchial arteries immediately after leaving the arch divide and subdivide to supply the labyrinthine organ. The second pair of efferent branchial arteries after leaving the arch runs along the posterior surface of the branchial chamber. After running for a short distance, the second efferent artery divides into two main branches, one supplying the membrane lining the posterior region and the other the anterior region of the branchial chamber. Thus the first and second pairs of efferent branchial arteries do not communicate with the circulus cephalicus.

The third efferent branchial artery, on leaving the postero-dorsal end of the third arch, curves round the fourth internal branchial cleft and runs posteriorly towards the mid-ventral line to meet the fourth efferent branchial artery (Fig. 1) of its own side, the two

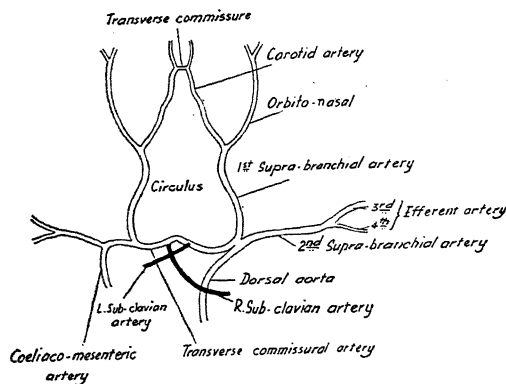


FIG. 1. Efferent branchial arteries in *Anabas testudineus*. (First and second pairs of efferent arteries not shown.)

together form the second supra-branchial artery which runs inward to meet the first supra-branchial artery. The left second supra-branchial artery gives rise to the coeliaco-mesenteric artery before its union with the first supra-branchial. The dorsal aorta is formed from the junction of the first and second supra-branchials of the right side. Thus the dorsal aorta does not arise from a central position but asymmetrically from one side. It curves towards the mid-ventral line of the head before running posteriorly. Finally, the right and left supra-branchial arteries are joined together by the transverse commissural artery.

To my knowledge the present work is the first account of the efferent arteries in *Anabas testudineus*. The peculiar condition present (similar to that found in *Ophicephalus*), in which the first and second pair of efferent arteries do not communicate with the dorsal aorta directly or indirectly, and also the asymmetrical disposition of the system, can only be accounted for because of the air-breathing habit and the similar position of the air-breathing organs; and so it affords a remarkable example of similarity of the efferent branchial arteries due to functional parallelism.

Dept. of Zoology, DEVENDRA B. SAXENA.  
The University, Lucknow,  
April 26, 1956.

1. Ridewood, W. G., *Proc. Zool. Soc. London*, 1899, 936.
2. Lele, S. H., *J. Linn. Soc. London (Zool.)*, 1934, 257, 49.
3. Wu, H. W. and Chang, H. W., *Sinensia*, 1946, 7 (1/6), 1.
4. Das, S. M. and Saxena, D. B., *Copeia*, 1956, 2, 100.

#### EFFECT OF $\gamma$ -(3 INDOLYL)-*n*-BUTYRIC ACID ON THE LEAF MOVEMENT OF *MIMOSA PUDICA* LINN. IN DIFFUSED DAYLIGHT AND ARTIFICIAL LIGHT

IN 1934 Burkholder and Pratt<sup>1</sup> showed that a small amount of pure  $\beta$ -indolyl acetic acid applied in lanolin paste on the upper and lower surfaces of the pulvini of different plants, both in darkness and in light, caused upward and downward movement of the petiole as the hormone paste was applied below or above in turn. The leaflets remained open or closed according to the applications made on the upper or under surface of the pulvini. Lanolin paste without the hormone was ineffective.

Working with 0.8% of  $\gamma$ -(3 Indolyl)-*n*-butyric acid in lanolin paste we found entirely different results. In diffused daylight at 8-30 a.m. the paste when applied on the lower side of the pulvini of different plants caused continuous gradual upward deflection of the petiole (Plate I a) for 2 hours (temperature 19.0° C. to 20.3° C.). Then there was a faster downward movement of the treated leaves as compared with untreated ones for 3 hours and 30 minutes (temperature 20.5° C. to 21.4° C.), after which there was again an upward movement for 2 hours and a downward deflection till evening. Control leaves showed a gradual downward movement from 2-30 p.m. to 5-30 p.m. This type of up and down move-

ment of the treated leaves at intervals of time was not observed by Burkholder and Pratt.

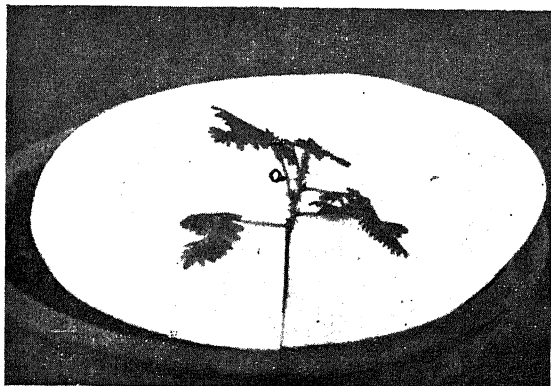


PLATE I a. Photograph showing the upward deflection of the petiole when treated with 0.8%  $\gamma$ -(3-Indolyl)-*n*-butyric acid.

When the hormone paste was applied on the upper side of the pulvini, in diffused daylight as well as in artificial light, the leaves moved rapidly downwards (Plate II a). Unlike the

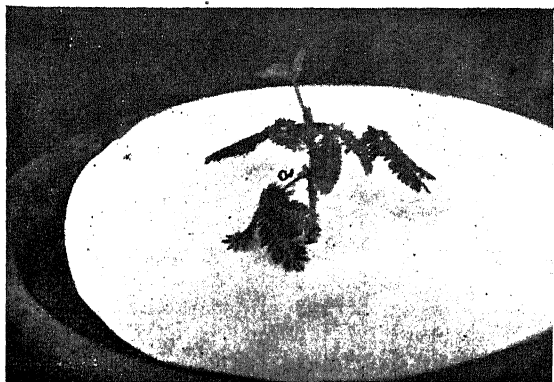


PLATE II a. Photograph showing the downward deflection of the petiole when treated with 0.8%  $\gamma$ -(3-Indolyl)-*n*-butyric acid.

observations made by the above authors,<sup>1</sup> in both cases of applications of the paste on the lower and upper sides of the pulvini, the leaflets remained perfectly open throughout.

In artificial light of two 500 watts Osram bulbs, heating effect of which was checked by a water jacket, the hormone paste applied on the lower side of the pulvini at 8-15 p.m. caused rapid upward movement for 6 hours. Then there was a continuous downward trend for 3 hours and 35 minutes. This was not observed in control plants.

Comparing the rate of movements in the treated leaves in diffused day as well as in

artificial light, we found that it was faster in artificial light than in diffused daylight—a phenomenon not observed till now.

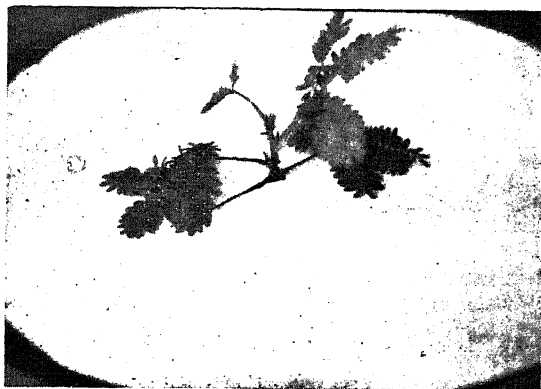


PLATE III. Photograph of the control plant.

The angle of movement of the petiole was measured by adopting the method used by Wallace<sup>2</sup> throughout our investigations.

We conclude from our experiments that in addition to  $\beta$ -indolyl acetic acid,  $\gamma$ -(3-Indolyl)-*n*-butyric acid also has some effect on the movement of *Mimosa pudica* L. leaves. The cause of this type of movement is due to some complex changes produced by the introduction of this auxin within the cells of the pulvinus, which may result in a sudden increase of turgor pressure in one half of the pulvinus.

Dept. of Botany,  
Plant Physiol. Labs.,  
University of Allahabad,  
February 20, 1956.

SHRI RANJAN.  
A. K. DUTT.  
B. MALAVIYA.

1. Burkholder, P. R. and Pratt, R., *Amer. J. Bot.*, 1936, **23**, 46.
2. Wallace, R. H., *Ibid.*, 1931, **18**, 215.

#### ETHYL MALONATE—AN INHIBITOR FOR TERMITE CELLULOSE

IN continuation of the earlier communication of Misra and Ranganathan<sup>1</sup> on the properties of the cellulose digesting enzymes present in the hind gut of the 'higher' termite, we wish to draw attention to the results obtained on the use of ethyl malonate as an inhibitor for the cellulases found in the gut extracts of both the 'higher' termite, *Termes* (*Cyclostermes*) *obesus* Rambur and the 'lower' termite, *Hetero-stermes indicola* Wasmann.

The experimental techniques employed for the preparation of the gut extracts and the estimation of the cellulase activity were largely

the same as described by Misra and Ranganathan.<sup>1</sup> The ester was added to a mixture containing cellulose suspension, phosphate buffer and the gut extract in concentration of 0.5, 1.0 and 2.0% by weight of the total mixture. The results obtained with the two species of termites are given in Table I.

TABLE I

Cellulase activity of the gut extracts of *Termes* (*Cyclotermes*) *obesus* and *Heterotermes indicola* in the presence of ethyl malonate

Concentration of ethyl malonate (%)	Hydrolysis of cellulose (%)*	
	<i>T. (Cyclotermes) obesus</i>	<i>H. indicola</i>
Nil	19	50
0.5	18	25
1.0	9	19
2.0	Nil	Nil

\*Expressed in terms of glucose.

The results given in the table show that in the presence of ethyl malonate, the hydrolysis of cellulose is inhibited. With the rise in the concentration of the inhibitor, there is an increase in the inhibition observed and at 2% level there is complete suppression of the cellulolytic activity. That the ester has a direct inhibitory action on the cellulase system and that the suppression of the hydrolysis of cellulose was not the result of this ester blocking one or more enzymes which are involved in the oxidation of glucose will be clear from the following: (a) At a suitable concentration (2%) the hydrolysis of cellulose was completely suppressed as is evidenced by the absence of reducing sugars. (b) The inhibition by the ester of one or more enzymes involved in the subsequent oxidation of glucose will result in the accumulation of the corresponding substrates for the enzymes involved. This will have a retarding effect on the oxidation of glucose resulting in the accumulation of the reducing sugar. On the other hand, the results obtained show that with increase in the concentration of ethyl malonate, there is a gradual reduction in the amount of reducing sugar liberated.

Malonic acid has long been known to be a metabolic inhibitor for the succinic dehydrogenase system.<sup>2-4</sup> The results obtained in the present investigation show that diethyl malonate is also capable of inhibiting the cellulase enzyme system.

We wish to thank Dr. T. S. Subramanian and Mr. S. K. Ranganathan for their interest in this work.

Tech. Development Estt., J. N. MISRA.

Kanpur, April 9, 1956. P. K. VIJAYARAGHAVAN.

1. Misra, J. N. and Ranganathan, V., *Proc. Ind. Acad. Sci.*, 1954, **39B**, 100.
2. Quastel, J. H. and Wheatley, A. H. M., *Biochem. J.*, 1931, **25**, 117.
3. Thunberg, T., *Biochem. Z.*, 1933, **258**, 48.
4. Thorn, M. B., *Biochem. J.*, 1953, **53**, 1.

### METABOLIC MEIOTIC IRREGULARITIES IN *CYCLOSORUS REPANDULUS* (v.A.v.R.) CHING

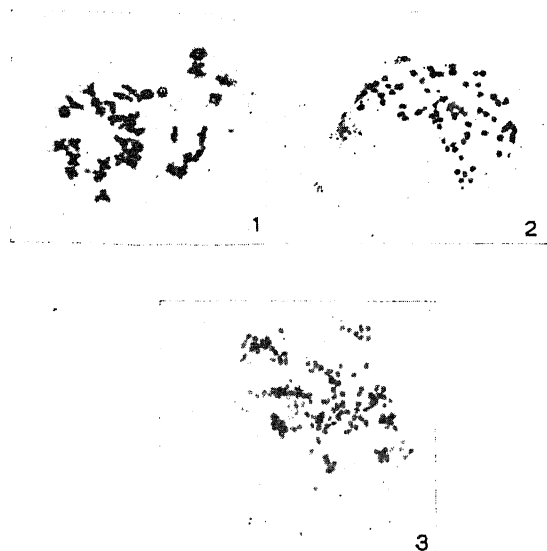
DURING the studies in cytotaxonomy of certain tropical species of ferns, a few plants of *Cyclosorus repandulus* (v.A.v.R.) Ching<sup>1</sup> were grown from spores inside a glass-house maintained at high humidity and high temperature (*viz.*, 80°-85° F.) at Leeds. These plants were growing luxuriantly well until a few fertile fronds were produced in about 11 months' time from the date of sowing of the respective prothalli. Due to the limitations of space inside the hot house, however, a few of these plants were transferred to an adjacent warm glass-house kept at low humidity and temperature (*viz.*, 55°-60° F.) to determine as to whether they can withstand this change.

The transferred plants lost their luxuriance and the sori on the freshly-produced fertile fronds appeared less conspicuous than usual. It was, however, remarkable to find that while the chromosomes of the plants of *C. repandulus* still kept in the hot house regularly formed 36 bivalents (Fig. 1), the chromosomes of the transferred plants showed complete failure of pairing and formed 72 univalents (Fig. 2).

This finding appeared problematic to start with, but Manton<sup>2</sup> has repeatedly observed failure of pairing of chromosomes in tropical species, newly transplanted in temperate conditions and considers that "such metabolic failure of pairing can be met with as a rare abnormality in well-established plants subjected to unusual growing conditions". It is, therefore, plausible that the formation of 72 univalents in the present case was induced by metabolic changes consequent upon the transfer of the plants from the hot house atmosphere to that of the warm one.

In addition to the cells with 72 univalents, however, the same plant produced cells with

144 univalents, without any multivalents at meiosis (Fig. 3). It may probably be due to



FIGS. 1-3. Microphotographs,  $\times 670$  approx.

FIGS. 2-3 are photographs of two cells under the same coverslip

the formation of a restitution nucleus either through the failure of the second division of meiosis in cells with 72 univalents or through the failure of premeiotic mitosis and subsequent metabolic failure of pairing under the conditions of the warm house.

Grateful thanks are due to Professor I. Manton, The University, Leeds, for supervision and guidance.

Ravenshaw College,  
Cuttack, May 28, 1956.

G. PANIGRAHI.

1. Panigrahi, G., *Curr. Sci.*, 1955, **24**, 238.
2. Manton, I. and Sledge, W. A., *Phil. Trans. Roy. Soc.*, London, Series B, 1954, **238** (654), 127.

# A SPONTANEOUS AUTOTETRAPLOID GRAM (*CICER ARIETINUM* L.)

RAMANUJAM AND JOSHI<sup>1</sup> obtained several autotetraploid grams by treating seeds of I.P. 25 strain with colchicine. The plants of the  $C_1$  generation were mostly mixoploids containing  $2n$  and  $4n$  sectors, but in the subsequent generation pure tetraploids were obtained. The tetraploids possessed a larger number of leaves per plant, bigger leaflets, flowers, pods and

seeds than diploids, but lesser number of branches. The pollen grains in the tetraploids were larger and about 40-80% were sterile. Varying number of quadrivalents were observed at diakinesis and metaphase I, seven quadrivalents per cell occurring most frequently.

In about half-an-acre of gram field sown with seeds of Type 87 obtained from the Department of Agriculture, West Bengal, 2 sterile and 3 semi-sterile plants were obtained. One of the semi-sterile plants was found to be an autotetraploid. The plant was conspicuously uniform in the expression of gigas character in all parts. It was slow-growing, spreading in habit and had larger number of branches though many of them were short. Height was less, but it covered a wider area with its spreading habit, the diploid being semi-erect. It had more or less the same number of leaves as the adjacent diploids. The leaflets were not only bigger but also appreciably coarser and thicker. The palisade cells, stomata and the hairs on the surface of the leaves were larger in the tetraploid. The flowering started at the same time as the diploids, but the range of flowering period was much longer. The big flowers had much larger stalks than the diploids. The pods and seeds were more or less similar to the diploids. Empty pollen was about 60% and the size of the stainable pollen varied considerably.

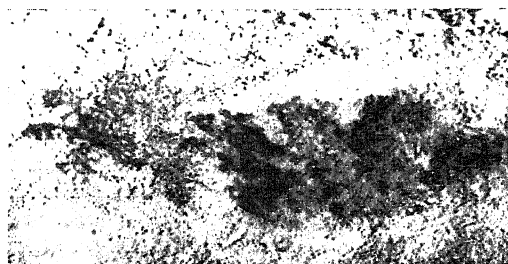


FIG. 1. Diploid and the spontaneous autotetraploid gram plants and their leaves and flowers.

The autotetraploid nature of the plant was established from meiotic study through temporary acetocarmine preparations of pollen mother cells. 32 Chromosomes could easily be

counted in several plates. At diakinesis and metaphase, though the chromosomes mostly formed bivalents, univalent and quadrivalent configurations were also common. Subsequent meiotic irregularities were not very conspicuous.

Differential response to tetraploidy of strains within the same species having similar chromosome complement have been observed in several plants.<sup>2,3</sup> The differences observed between the spontaneous autotetraploid of Type 87 and the induced autotetraploid of I.P. 25 are thus not unexpected. Conspicuous difference in characters among the six colchicine induced tetraploids obtained from the different strains of gram has also been observed by Srivastava.<sup>4</sup> These indicate that a wide range of diploid strains should be used in gram for producing tetraploids and to utilize the differential reaction in regard to the economically important characters.

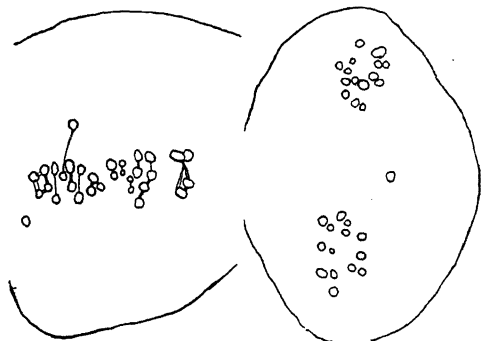


FIG. 2. Meiotic metaphase I and anaphase I of the autotetraploid gram.

Spontaneous origin of tetraploid plants or plant sectors is a common phenomenon and speciation through autopolyploidy was once thought to be widespread. Clausen, Keck and Hiesey<sup>5</sup> and Stebbins<sup>6</sup> hold that autopolyploidy has played only a minor role. Like this semi-sterile autotetraploid, they are greatly handicapped to establish themselves successfully under natural conditions and more so in competition with the diploids among which they arise. Even under special cultural conditions provided for the crop plants, the progenies of the tetraploid gram will be handicapped due to the semi-sterility, till the fertility can be improved by selection at later generations.

Indian Inst. of Technology, NIRAD K. SEN.

Kharagpur,

MANAS K. JANA.

March 20, 1956.

1. Ramanujam, S. and Joshi, A. B., *Ind. J. Agric. Sci.*, 1941, **11**, 835.
2. Varma, A., State Hort. Inst. Pukka, Finland, 1947.
3. Nilsson, F., *Hereditas*, 1950, **36**, 181.
4. Srivastava, R. N., *Proc. Bihar Acad. Sci.*, 1955, **4**, 59.
5. Clausen, J., Keck, D. D. and Hiesey, W. M., Publ. No. 564, Carnegie Institute, Washington, 1945.
6. Stebbins, G. L., *Variation and Evolution of Plants*, Columbia University Press, New York, 1950.

## ON TWO SPECIES OF *RICCIA* NEW TO INDIAN FLORA

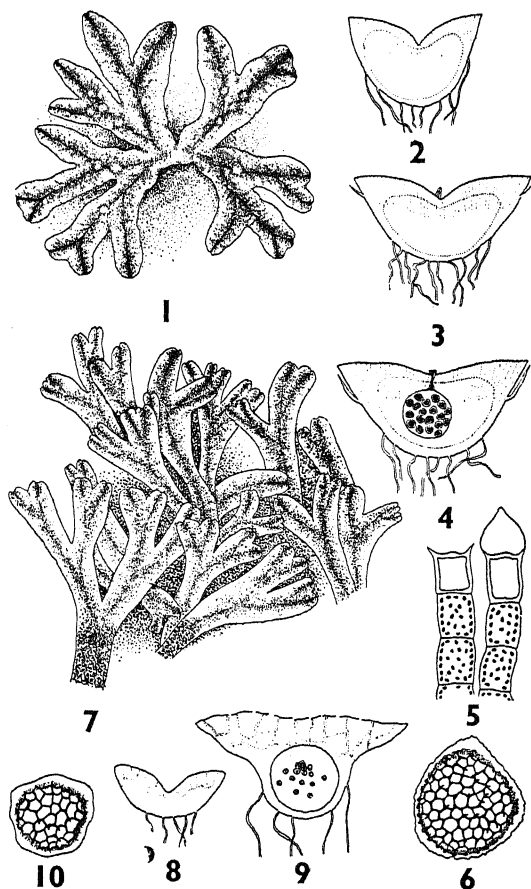
A study of the several species of *Riccia* from the extensive "Pandé collections" revealed the presence of *R. sorocarpa* Bisch. and *R. huebeneriana* Lindenb., the two common European species described by Müller,<sup>1</sup> Macvicar,<sup>2</sup> Meijer<sup>3</sup> and others. Both these have not so far been recorded from this country. A brief illustrated note to bring out the salient features of these species is given below:

Specimens of *R. sorocarpa* were at first collected by Dr. S. K. Pandé, during his tour of the Sikkim-Himalayas in September-October 1941, from the compound of the Dak bungalow in Phaloot (ca. 12-13,000'). It was subsequently collected by Dr. M. N. Bose of the Institute of Palaeobotany, Lucknow, from Ratni Jhal (ca. 11,000') during his tour of Spiti in August 1952. The plants in the latter collection were found intermingled with *R. gangesica* Ahmad and are relatively smaller, being only up to 2.5 mm. long and normally less than 1 mm. broad. Specimens in both the collections are fertile.

*R. sorocarpa* is monocious and forms rosettes (Fig. 1). It has narrow air-spaces (Figs. 2-5) characteristic of the *Euriccia* section of the genus. The epidermis (Fig. 5) consists of two layers of cells—the upper is mammilate and usually disorganises while the lower is cubical with thick walls and persists. The epidermal character of this species provides a valuable diagnostic feature. The spores are tetrahedral, prominently winged (Fig. 6) and 60-95  $\mu$  in maximum diameter with 8-10 areoles on the outer face.

Specimens of *R. huebeneriana* were also at first collected by Dr. Pandé, during his tour of the Sikkim-Himalayas, at a distance of about 7 miles from Darjeeling (2,500') on moist ground on a footpath leading to Badampton. This species has since been identified from specimens of liverworts collected from Kisli

Forest, Mandla, Madhya Pradesh, in August-September 1954, by Mr. R. M. Singhal, Forest Planning Officer, and kindly sent to the author. Specimens in both these collections are fertile.



FIGS. 1-6. *R. sorocarpa* Bisch. (1). Habit sketch showing a rosette,  $\times 4$ . (2-4). Transverse sections of a thallus from apical region, middle and base,  $\times 16$ . (5). A part of t.s. of thallus showing assimilatory cells and the epidermis,  $\times 140$ . (6). Outer face of a spore,  $\times 140$ .

FIGS. 7-10. *R. huebeneriana* Lindenb. (7). Habit sketch showing overlapping thalli,  $\times 4$ . (8-9). Transverse sections of a thallus from apex and base,  $\times 16$ . (10). Outer face of a spore,  $\times 140$ .

*R. huebeneriana* is monœcious and the plants are 2-4 times dichotomously branched (Fig. 7) with large air-chambers (Figs. 8, 9) characteristic of the section *Ricciella* of the genus. The older parts of the thalli show prominently pitted appearance (Figs. 7, 9) due to disorganisation of the epidermal cells. The sporogonia conspicuously project ventrally (Fig. 9). The spores are tetrahedral, broadly winged (Fig. 10) and  $50-65\mu$  in maximum diameter with 6-8 areoles on the outer face.

Recording of *R. sorocarpa* and *R. huebeneriana* from India extends not only the range of distribution of these species in the Eastern countries but also the occurrence of the former in Phaloot (ca, 12-13,000') and Ratni Jhal (ca, 11,000') widens the range of altitude recorded for this species so far.

Dept. of Botany,  
Lucknow University,  
Lucknow, April 10, 1956.

RAM UDAR.

1. Müller, K., "Die Lebermoose Deutschlands, Oesterreichs u. d. Schweiz I," *Rabenhorst's Kryptogamenflora*, 1906-11, Bd. 6, Leipzig.
2. Macvicar, S. M., *The Student's Handbook of British Hepatics*, 1926.
3. Meijer, W., *Overg. uit het Nederlandsch Kruidkundig Archief*, Deel, 1951, 58, 122.

#### A NEW GROUNDNUT—*ARACHIS HYPOGAEA*, LINN., VAR. *OLEIFERA* *FORMA ERECTA*, JOHN ET SESHADRI (FORMA NOVA.)

Two distinct habits of groundnut, viz., the bunch-type (Fig. 1) and the spreading type (Fig. 2) have long been known to botanists and breeders. A new type of habit, viz., the trailing or running habit is that of the variety *Arachis hypogaea*, Linn. var. *gigantea*, Patel et Narayana.<sup>1</sup> But yet another new variety of groundnut described here has the unique and hitherto unrecorded habit, viz., the erect habit (Fig. 3). John and others<sup>2</sup> have classified it as separate form under variety *Oleifera*.

#### DESCRIPTION OF THE NEW FORM

This form conforms essentially to the original species, viz., *A. hypogaea*, Linn. but is distinct from any of the numerous forms and varieties that have been recorded, in having a definitely erect type of habit.

It is essentially a small, short and stunted plant (Fig. 3) attaining a height of only about 30 cm. even under the best conditions and usually with 6-8 thin (0.26 cm. across) primary and 6-12 shorter secondary branches all growing quite erect and parallel to each other and the main axis. The internodes are short (1.40 cm.). The leaflets are also rather small, being only  $3.5 \times 2$  cm. Flowers are small, orange-yellow in colour, 1-3 in axillary clusters chiefly confined to the basal nodes of the branches. The calyx tube is very thin (0.1 cm. across) and about 3.5 cm. long. Eight stamens and one staminode form the monadelphous tube. Gynophore is very thin (0.90 mm.) and purplish in colour. The pods are puny ( $1.0-3.2 \times 0.8$  cm.), one- to three-seeded with

## Growth Habit of Groundnut

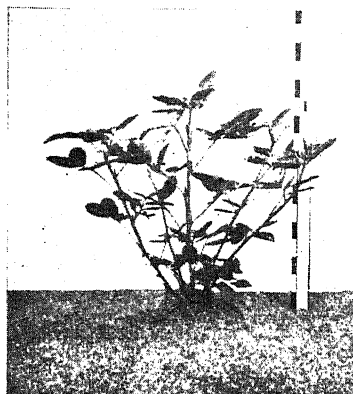


FIG. 1. Bunch

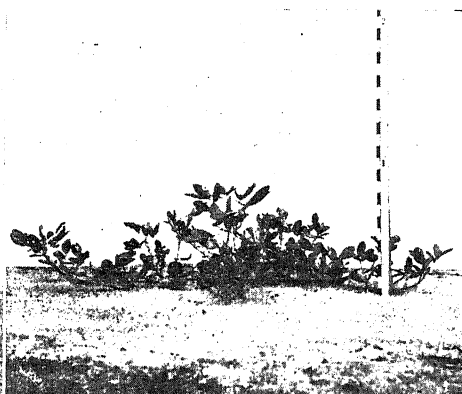


FIG. 2. Spreading



FIG. 3. Erect

prominent beak and distinct veins. Shell is thin (0.9 mm.). Seeds are very small (1.0 cm.  $\times$  0.7 cm.), rose coloured, somewhat rounded and not plump. The oil content of the seed is about 50%.

**Genetic History.**—It is a form isolated in 1936 from a cross between Spanish 10 (Bunch habit) and H.G.1 (semi-spreading habit) at the Groundnut Research Station, Tindivanam. Genetically it is a double recessive for the bunch and semi-spreading habits. This form has been crossing freely with all groundnut varieties, and is also breeding true to type.

The type is deposited in the Madras Herbarium, Coimbatore, and is also being cultivated at the Groundnut Research Station, Tindivanam, South Arcot District (Madras).

Dept. of Agriculture,  
Oilseeds Wing,  
Madras, March 13, 1956.

C. M. JOHN.  
C. R. SESHADRI.

1. John, C. M. and Seshadri, C. R., *Curr. Sci.*, 1936, 4, 737.
2. John, C. M. *et al.*, *Indian J. Agri. Sci.*, 1954, 24, Part IV, 165; 174.

#### AN ERIOPHYID MITE ON SUGARCANE IN SOUTH INDIA

ERIOPHYID mites are generally of economic importance and are commonly known as gall mites, blister mites, rust mites and bud mites. They produce malformations on plants and such formations are called "acarocedidii". Members belonging to this group of Acarina have been found to cause damage to fruit crops such as grapes, citrus, figs, peaches, plums, berries, etc., in foreign countries.<sup>1</sup> In South India they have also been recorded on

various plants such as *Zizyphus jujuba*, *Grewia microcos*, *Camellia theifera*, *Gossypium herbaceum* and *G. indicum*<sup>2</sup> and Jasmine.<sup>3</sup> During the survey of sugarcane crop conducted recently at Vadapathimangalam area in Tanjore District the existence of eriophyid mites on this crop has come to light. Their presence on sugarcane was recorded previously by Van Hall<sup>4</sup> in Java and Harold E. Box<sup>5</sup> in Queensland. This is the first record of the occurrence of these mites on sugarcane in India and this is the third country in the world in which the mite has been recorded to occur.

The mites are very minute with a worm-like body and feeding on the inner side of leaf-sheath. They cause a circular erineum with shallow depression in the centre, forming dimple gall, which exhibits a characteristic swelling on the outer surface of leaf-sheath (Fig. 1). The inner side of the erineum appears

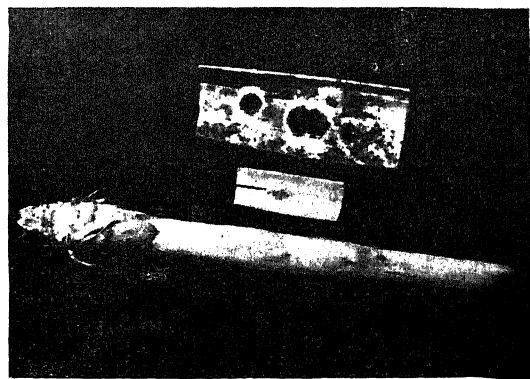


FIG. 1. Inner side of leaf-sheaths with erineum exposed and a shoot with external symptoms of attack.

as if dusted with a white powder, which is apt to be mistaken for fungal spores. On close examination, a large number of mites may be seen crawling inside the gall. They are slender and elongated with an annulated abdomen. They possess two pairs of legs which are distinctly seen near the anterior end, having a feathered hair from the tip of each tarsus (Fig. 2). The nymphs of these mites are found

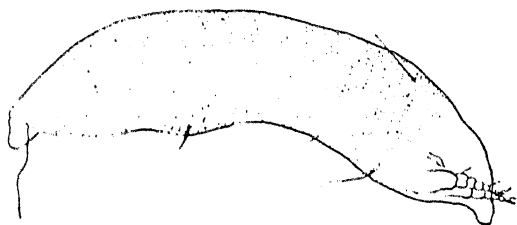


FIG. 2. Adult Mite.

with a pair of setiferous tubercles in the cephalothoracic shield and they are absent in the adults. In the midst of this mite colony, a large number of eggs are also present. The erineum caused by the mites is of light green colour in the initial stage, resembling more or less the colour of the inner surface of the leaf-sheath. It slowly turns rusty red due to a laceration of the tissues and gets hardened afterwards. In such cases no mites are seen inside the erineum, whereas saprophytic fungi, such as *Alternaria* sp., *Glæosporium* sp., and *Fusarium* sp., are present.

This mite is now recorded in the factory estate, Vadapathimangalam (Tanjore District), Central Sugarcane Research Station, Palur (South Arcot District), and the Central Farm area of the Agricultural College, Coimbatore, on variety Co. 419. Stray cases of incidence were also noticed in Co. 449 and Co. 527 at Palur and Vadapathimangalam. The mite is still awaiting identification.

The author wishes to express his thanks to the Sugarcane Specialist, Central Sugarcane Research Station, Palur, for first bringing its incidence to his notice, and to the Government Entomologist, Agricultural College and Research Institute, Coimbatore, for help rendered in the present study.

T. S. MUTHUKRISHNAN.

Central Sugarcane Res. Station,  
Palur, May 23, 1956.

1. Baker, E. W. and Wharton, G. W., *An Introduction to Acarology*, 1952, p. 465, Macmillan Co., New York.
2. Cherian, M. C., *Proc. Assoc. Econ. Biol.*, 1934.
3. Subramanyam, T. V., *Rep. Mysore Agric. Dept. for 1934-35*, 1936, pp. 23.
4. Van Hall, C. J. J., "Diseases and pests of cultivated plants in the Dutch East Indies in 1923," *Meded. Inst. Plantenziekten* No. 64, 47 pp.; *Buitenzorg*, Abstract referred in *Review of Applied Entomology*, 1924, 12, 572.
5. Box, H. E., *List of Sugarcane Insects*, Published by Commonwealth Institute of Entomology, 1953, London.

## DUTY ON MICROSCOPE SLIDES

IT would appear that the Central Board of Revenue has directed that microscope slides shall in future be assessable to duty as 'Glass and Glassware' under Item 60 of the Indian Customs Tariff. This means that the customs duty has been raised from 20% to 66 2/3%. Microscope slides are used essentially for scientific teaching and research, and there is good reason for classifying them as 'Scientific Appliances' (duty 25%) rather than 'Glass and Glassware', if not as 'Optical Appliances'

(20%). So far no manufacturer in this country is producing such slides of high quality, free from air bubbles and striae and plane parallel to a fairly high accuracy. The raising of duty will therefore affect a highly select class of students and scientific workers. As the expected increase in revenue from this source may never amount to much, we feel that this is a matter for reconsideration by the authorities concerned.



---

 REVIEWS
 

---

Steels for the User. Third Edition. By R. T. Rolfe. (Chapman & Hall, London), 1955. Pp. xvi + 399. Price 45 sh.

The aim of the book, in the words of the author himself, is "to bridge the gap between science and practice for carbon steels in industry". The gap exists because of an insufficient awareness by the engineer and most other users of the criteria which determine the suitability of steels for selection for different purposes. There is an undoubted need for a text-book to bridge this gap and this need is adequately met by this well-known text-book, now in its third edition.

The scope of the book may be gathered from the following selection of chapter headings, picked at random: mechanical quality and its assessment, covering in adequate detail the mechanical testing of metals, the heat treatment of steels—theoretical considerations, case hardening and similar treatments, fatigue testing and weld testing and treatment. They clearly indicate the nature of the background which is provided in order to help choose a suitable steel for a specific purpose. The general principles which guide the selection of steels for service are discussed briefly but clearly in the last chapter. Important topics like the evaluation of service data and of mechanical tests in relation to performance, the need for a factor of safety, its size and basis of calculation and factors affecting quality are considered with several illustrative examples. The discussion is based on a knowledge of the microstructures and mechanical properties of the steels and earlier chapters are devoted to a detailed and instructive presentation of these topics.

The book deals mainly with carbon steels, and alloy steels are not specifically dealt with, although reference is made to them on two or three occasions, *e.g.*, for nitriding and for use at elevated temperatures. On the other hand, a chapter on bright and free cutting steels deals adequately with typical steels of these varieties and the reasons for selecting them for special purposes.

The various processes and treatments are considered in a scientific manner and a number of practical examples from actual service is given by way of illustration. While the

theoretical portions are somewhat elementary, the book contains a wealth of information useful to the metallurgist and will indeed enable him to give better advice about the steels he manufactures or heat-treats. As for the engineer and the intelligent user, who possesses no theoretical background in metallurgy, the book answers a very real need and can be wholeheartedly recommended. It is superfluous to comment upon the excellence of printing and get-up of this Chapman and Hall publication.

BRAHM PRAKASH.

Synthetic Drugs. By H. Ronald Fleck. (Cleaver-Hume Press), 1955. Pp. viii + 380. Price 70 sh.

During the last 15 years, a large number of synthetic drugs have been introduced into modern medical practice, and chemists, pharmacists and medical men are all looking forward to books which can give a concise account of all the new work on synthetic drugs. This book has come at an opportune time and would be generally welcomed.

In 15 chapters, the author has described synthetic amœbacides, anæsthetics, analgesics and antipyretics, antibiotics, anti-convulsants, anti-histaminics, anti-malarials, anti-tuberculous drugs, autonomic drugs, cardiac drugs, hormones, hypnotics and sedatives, muscular relaxants and hypotensive drugs, sulphonamide drugs and the vitamins. From the chapter titles, it would appear that a complete coverage of the new synthetic drugs has been achieved, but several gaps are noticeable in each chapter. There appears to be some lack of balance in the presentation of the subject-matter in that generally more weightage has been given to some chapters than others. Several cardiac glycosides have not been discussed while such cardio-vascular agents as Khellin, Pronestyl, etc., have been brought in. The book is not likely to be of immediate use to medical people, because the chemistry involved in the formulæ and in the preparatory details regarding synthesis is much more than a medical man will find it convenient to absorb. In view of this, it is not understood what purpose the 'clinical index' at the end is going to serve. It may give inducement to pharmacists to use drugs without a doctor's prescription.

To the chemists and pharmacists, the book would be useful, as detailed accounts of such natural products as quinine, penicillin, streptomycin, etc., are given, including a fairly systematic account of intermediates and penultimate products involved in synthetic processes. However, a fair number of incorrect statements and mistakes in structural formulæ have crept in. A notable example is the formula of emetine. No doubt these will be attended to in a future edition.

In view of the tremendous addition to knowledge in the field of antibiotics, the author has found it necessary to add a 'supplement' where almost all the recent antibiotics are discussed. He has also included an account of a recent 'antispasmodic'. However, there is no mention of vitamin B<sub>12</sub>, an important recent addition in the group of vitamins.

A lot of data has been incorporated in the book, and the author is to be congratulated in being able to collect and compile so much useful information in less than 400 pages. Probably the idea of the author to compile a book which would be equally valuable to medical men, pharmacists and chemists stood in the way of his achieving an overall balance of presentation. The reviewer cannot think of any book which can be equally valuable to these three classes of people, though it is conceded that much of the ground in which these people operate is common. A pharmacopœia or a pharmaceutical codex is likely to be more valuable to a medical man than a book of this type. The pure chemist interested in synthesis would perhaps ask for more data than has been incorporated here. Possibly in a future edition the author will look into these aspects and try to re-edit the book keeping in view the requirements of chemists and pharmacists rather than that of a medical man. If some of the gaps are filled in and the extraneous material pertaining to pharmacology and dosage of drugs removed, a more balanced and useful book would emerge, which would be a constant companion to many interested in synthetic drugs in the laboratory as well as in manufacturing establishments.

B. MUKERJI.

**Advances in Veterinary Science, Vol. II.** Edited by C. A. Brandly and E. L. Jungherr. (Academic Press), 1955. Pp. xii + 449. Price not given.

The present volume, like its predecessor in the series, is a collaborative work to which

contributions are made by scientists, who are well known for research in the respective subjects covered in the book. Eleven different themes, representing broad and important aspects of veterinary science, are written by specialists from America, Africa, Scotland and New Zealand. The objective of this volume remains the same as stated in Volume I, *viz.*, "to review the progress in the more active fields of research embracing and pertinent to veterinary medical science and in the application of the knowledge to the art and practice of veterinary public health", which "may be of the greatest use to the serious student, the research worker and the practitioner".

"Epizootiology of Virus Diseases", by Richards E. Schope, describes some of the recent findings contributing to a better understanding of the epizootiology of virus diseases of veterinary importance. Chester W. Emmons writes on "Mycoses of Animals" dealing with the disease-producing potentialities of twelve fungi, which have recently assumed new importance in veterinary medicine. Henry Van Roekel describes "Respiratory Diseases of Poultry" which, in modern poultry production, constitute an economic problem and which are worldwide in scope. The author concludes that on account of the many common features and their geographical distribution of these various respiratory diseases, if types of strains and type antisera of the different diseases could be established and made available to competent official laboratories for the identification of etiologic agents isolated in the various countries, it would be an international facility to mark progress in the control of the avian respiratory diseases.

"The Blood Groups of Animals" are dealt with by L. C. Ferguson, who is a well-known authority on bovine antigens and for his method "Hæmolytic Test" used in bovine blood typing. He says, "The work with bovine blood suggests that there is a very real probability that antigens of the blood will be found which are associated genetically with level of milk production. These proposed applications of immunogenetics as tools to aid in selection and breeding of better animals are fascinating to contemplate and will of course be a valuable tool for the practical animal breeder". This would seem to be almost an accomplished fact since the various pure-bred cattle associations in U.S.A. have been using blood typing as an aid in maintaining the integrity of the records for several years. The blood typing, as evidence

in a recent judgment in Canada, against a defendant accused of falsifying the registration of pure-bred cattle, points to its infallibility in the legal sense as in human cases.

I. J. Cunningham discusses "Diseases Caused by Deficiencies of Trace Elements", and control measures on a national scale as cobalt and copper deficiencies are of wide occurrence throughout the world.

N. T. Clare writes on "Photosensitization in Animals", in which 23 plant poisonings and other conditions which affect livestock, are discussed. Fifteen of these are classified as hepatogenous photosensitivity.

"Rumen Dysfunction" is dealt at length by A. T. Phillipson. The physiology of the alimentary tract is discussed in the broadest sense to include the microbiological and biochemical events of the stomach and gut in the young suckling as well as adult ruminants.

J. C. Shaw describes "Bovine Ketosis" in detail, with reference to incidence, etiology, diagnosis and therapy. "Tickborne Rickettsioses in South Africa" by D. A. Haig, and "Vibriosis" by W. N. Plastringe, summarize the principal advances in these subjects.

"Effective Control of Internal Parasites", the final essay, is written by Donald C. Boughton, who concludes, "The prime motivation for undertaking parasitic control is the profit to be derived therefrom".

The well authenticated references under each chapter, the classified author and subject index at the end add value to the work. Further volumes in the series will be eagerly awaited.

V. MAHADEVAN.

#### Some Beautiful Indian Trees. Second Edition.

By E. Blatter, W. S. Millard and W. T. Stearn. (Bombay Natural History Society, Bombay), 1954. Pp. xv + 165. Price Rs. 20 or 30 sh.

#### Some Beautiful Indian Climbers and Shrubs.

By N. L. Bor and M. B. Raizada. (Bombay Natural History Society, Bombay), 1954. Pp. viii + 286. Price Rs. 22.

These two delightfully published books with fascinating colour plates and half-tone reproductions have to be welcomed by the amateur botanist, or, shall I say, the amateur naturalist and the serious-minded professional. The word 'amateur naturalist' has somewhat partially, if not wholly, lost its meaning in Modern India. In the frightful craze for more and more specialisation in narrower and narrower fields

and with the advent of application of physical sciences in interpreting biological norm, the fashion of the day is a relentless and ruthless derivation of formulæ and equations. Against this outlook it is most pleasing to read through the decorative and colourful pages of these two volumes which together open a new field to naturalists in India, not only of emulating these publications and bringing out similar descriptive keys to our floras but also to acquire common field knowledge of the trees and shrubs around us.

The first book is written in very popular style with description followed by details of distribution, flowering season, gardening notes, uses and vernacular names. While considering whole genera, a key is given which would help in distinguishing the various species. The appendices would be found very useful as they include: descriptions of families represented; key to genera described; changes in nomenclature; glossary of some botanical terms and finally, a useful index. The printing and get-up of this book is better as it has been printed by the very experienced printers, Oliver & Boyd.

The second book satisfies the needs of the keen amateur gardener as well as a student of botany. It has a fairly comprehensive key to the species described in addition to a good description of the genus. A very useful glossary of the botanical terms used and an index of scientific terms terminates the book. The colour plates are excellent and life-like although the printing of the text is not all that is to be desired.

In my opinion the popularity of these two publications should be second to none both in our colleges and future upgraded High Schools and in the personal libraries of lovers of nature. To those who feel that the Linnaean age has given place to an experimental one, these books would serve as a reminder to the immense pleasure that both the amateur and the experimentalist can derive from a study of the floras around them with these splendid twin companions by their side.

T. S. SADASIVAN.

**Inorganic Nitrogen Metabolism.** (*Function of Metallo-Flavoproteins—A Symposium.*) Edited by W. D. McElroy and Bentley Glass. (The Johns Hopkins Press, Baltimore), 1956. Pp. xiii + 728. Price \$ 10.00.

There are few subjects of specialisation in biology that have gripped the biologist, biochemist, physical chemist and physicist, not to

talk of the votaries of the new hybrid disciplines of geochemistry and biogeochemistry as the inorganic nitrogen metabolism of micro-organisms, plants and animals. From small, modest and almost obscure beginnings in the second half of the nineteenth century, the subject has now come to be regarded, as more and more evidence accrues, a physico-chemical problem where key heavy metals like molybdenum take part in both nitrogen assimilation and fixation because of their general function in electron transport. This symposium organised by the McCollum-Pratt Institute of the Johns Hopkins University is probably one of the most elaborately and carefully planned ones the reviewer has come across. The major chapters are: Role of molybdenum in plant nutrition; Nitrate and nitrite metabolism by plants and micro-organisms; General processes of nitrification and denitrification; Nitrogen fixation; Comparative aspects of ammonia metabolism; Metabolic relationship between molybdenum and other metals—Function of metallo-flavoproteins; Summary (a splendid overall summary by Bentley Glass); Author and subject index. These chapters summarise the mass of data presented by the many participants.

One thing is obvious from this symposium: the problem of nitrogen metabolism centres round enzyme systems as they fit into basic nutrition of micro-organisms, plants and animals. The fundamental pathways of physiology and nutrition are very similar and, of course, alternate pathways are abundant as one considers intermediates and these could in turn emerge either through genetic adaptations or substitution of the various prosthetic groups. Many new techniques have been used in the discoveries presented and it serves to emphasise the need for selfless team work. I say this because every conceivable physical instrument has been successfully employed especially in detecting cytochrome c using double beam recording spectrophotometers, and in the case of identification of gases evolved in anaerobic reactions by the use of mass spectrometers.

To my mind the most interesting chapter is the one dealing with hydrogenase-nitrogenase activity of *Clostridium pasteurianum* which has a soluble hydrogenase and cell-free extracts prepared by sonic disintegration were purifiable 100-fold. This hydrogenase system is

able to utilise electron acceptor and is quickly inactivated by exposures to oxygen, carbon monoxide and nitric oxide. It has been pointed out that from the similarity of the nitrogenase and hydrogenase systems, nitrogen might be chemisorbed by the metal of the nitrogenase and then be reduced by the hydrogenase.

Certain major points that have emerged from this symposium: that nitrate like molecular nitrogen itself, constitutes a terminal pool which may be drawn upon by organisms; that hydroxylamine occupies a key position in nitrogen assimilation and synthesis of amino acids from inorganic matter and that molybdenum plays as important a role in the nitrogen cycle as iron in respiration and magnesium in photosynthesis.

I warmly commend the volume to all physiologists (of course, including biochemists and biophysicists engaged in border-line problems), for it is excellently edited, has an exhaustive bibliography and stimulating discussions at the end of each chapter by leading men in different fields of research collectively termed: General Physiology.

T. S. SADASIVAN.

#### Books Received

*Neuro-Otology*. (*British Medical Bulletin*, 1956, Vol. 12, No. 2, pp. 91-160.) (Agents in India: Oxford University Press.) Price 15 sh.

*Anuario Estatístico do Brasil*, 1955. (IBGE, Conselho Nacional De Estatística), 1956. Pp. xxxi + 639.

*The Distribution of the Standing Crop of Zooplankton in the Southern Ocean*. By P. Foxton. (Cambridge University Press.) *Discovery Reports*, Vol. XXVIII, 1956. Pp. 193-235. Price 7 sh. 6 d.

*Modern Methods of Plant Analysis*, Vol. I. Edited by K. Paech and M. V. Tracy. (Springer-Verlag, Berlin), 1956. Pp. xvii + 542. Price DM 108.

*Trace Elements in Human and Animal Nutrition*. By E. J. Underwood. (Academic Press), 1956. Pp. vii + 430. Price \$9.50.

*Automation—Friend or Foe?* By R. H. Macmillan. (Cambridge University Press), 1956. Pp. vii + 100. Price 8 sh. 6 d.

*Fertilization*. By Lord Rothschild. (Methuen, London, W.C. 2), 1956. Pp. ix + 170. Price 18 sh.

## VIRUS RESEARCH\*

*Advances in Virus Research*, Vol. II, contains two chapters on plant viruses, two on causing diseases of animals and of man, one on chemical constitution of viruses and three on biophysical aspects of viruses such as ionizing radiations on viruses, electron microscopy and hydration of viruses. Each is authoritatively written with an excellent bibliography.

The first chapter on 'Inheritance of resistance to viral diseases in plants' is a comprehensive survey on resistance, tolerance, hypersensitivity, localization and so-called immunity in plants to virus infections. This chapter concludes by reviewing the position on choice of experimental methods, a subject of considerable complexity, where the last word has not yet been said on what constitutes an ideal method of approach to breeding resistant varieties. The second chapter on 'Inhibitors and plant viruses' is a very ably written one on inhibitors of infection and inhibitors of virus increase in host tissue and in neither case is there chemical specificity and, indeed, their mode of action is still undetermined. In fact, there is no evidence that viruses such as the tobacco mosaic possess any independent metabolism, possibly not. All evidence suggests that they depend on synthetic systems of the host cells. However, more recent findings that high temperatures will free infected plants from viruses that are nucleoproteins indicate that conditions can be established in plants permitting synthesis of normal proteins whilst precluding synthesis of viruses *in vivo*.

Incomplete forms of influenza virus, a subject of topical interest, in so far as the human is concerned, is summarised in Chapter 3. The properties of the incomplete virus, the mechanism of production and the nature and origin of these viruses are discussed. The formation of incomplete virus (this term indicates the existence of non-infective virus particles which apparently are not degenerative product of the infective virus but mainly lacks power to initiate infection) does not seem to be confined to influenza virus; its occurrence is claimed in bacteriophages and in turnip yellow mosaic, the last differing from the normal mosaic virus in their lack of infectivity, lower sedimenta-

tion constant and chemically lack of nucleic acid. The chapter on 'Viral development in isolated animal tissues' emphasises the studies already made on viral inhibitors in animal tissues, especially on concepts of cellular homogeneity, structural precursors, analogues of methionine, purines and pyrimidines. It would appear that virus does not derive from the transformation of large preformed units of the cell, but rather arises from small cellular elements organised after initiation of infection and in the presence of energy-yielding mechanism.

Besides all these advances on the biological front, great strides have been made in the biochemical and biophysical fields of virology. The chapter on 'Action of ionizing radiation' indicates the need for independent study of action of radiation on proteins and nucleic acids and on the loss of function of viruses by a careful study of varying ionization density using fast electrons. The dexterity and energy with which research on electron microscopy of viruses has been pushed in recent years is fully described with ample space devoted to critical techniques employed in the chapter dealing with this subject. The measurement of virus shapes and sizes is particularly well dealt with. The chapter on chemical constitution of viruses presents a modern approach to solving the vexed problem of participation, directly or indirectly of viral nucleic acids in genetic schemes, although one can conjecture the major function of viral nucleic acid as one of holding the protein in a specific configuration making its several biological properties manifest; of course, strains of tobacco mosaic virus differing widely in protein composition and biological properties have identical size, shape, crystal habit, same number of polypeptide chains and same quantities of nucleic acid of identical composition!

The last chapter on 'Hydration of viruses' is a highly mathematical-cum-biophysical approach to questions relating to the nature of virus protein molecules of the crystallised type. Before understanding the structure of living organisms, the important problem to be solved is the size and shape of protein molecules and this can be done accurately only when the degree of hydration is known. Problems connected with their studies are discussed employing various biophysical methods.

\* *Advances in Virus Research* Vol. II. Edited by K. M. Smith and M. A. Lauffer. (Academic Press), 1954. Pp. x+313. Price \$ 7.00.

There can be no doubt about the importance of these splendid reviews in stimulating teachers and researchers into taking keener interest into this complicated "Web of life" from the invisible to the visible and the several stages

that these 'microbes' pass through in an eternal cycle of host-parasite variability. I warmly commend this volume to all interested in the fundamentals of 'origin of life and their evolution'.  
T. S. SADASIVAN.

## SCIENCE NOTES AND NEWS

### Removing Air Bubbles in Wet Mounts

Dr. H. S. Rao, Botany Branch, Forest Research Institute, Dehra Dun, observes: Many temporary aceto-carmin mounts are now being discarded on account of the air bubbles caused by the evaporation of acetic acid; but they can be reclaimed by using the following simple method:

A small portion of the sealing medium was scraped off on one edge of the coverslip and a drop of the stain solution was placed there. The slide was then introduced into a vacuum flask coupled to a Geryk Vacuum pump. On working the pump for a few seconds, the vacuum so created drew off the air bubbles from under the coverslip. Disconnecting the vacuum instantly resulted in suction of the stain solution under the coverslip, fully bathing the cells or tissues in that medium. The seal was then re-made.

### Chromosome Number of *Sesbania cinerascens*

Sri. M. S. Pawar and D. S. Borgaonker, Government Main Experiment Station, Hima-yet Sagar, Hyderabad Deccan, observe that the chromosome number of *Sesbania cinerascens* was found to be  $2n=12$ , using a fixative in the ratio 4 chloroform: 3 absolute alcohol: 1 glacial acetic acid as suggested by Turner (*Rhodora*, 1955, 55, 213). One or two anthers from a bud were first tested in aceto-carmin for proper stages and then the rest fixed in the above fixative. The anthers were subsequently removed and squashed in aceto-carmin. There were 6 II at I M and the subsequent stages were normal.

### Code for Atomic Structure of Solids

A new code for describing the atomic structure of solids was described by A. L. C. Rees, of the Australian Commonwealth Scientific and Industrial Research Organisation, at the Symposium on Crystallography held in Madrid recently.

The code makes it possible to describe concisely the irregularities in the atomic structure of crystalline solids. These irregularities are of special industrial importance. They are important in photography, fluorescent lamps, TV screens, luminous watch dials, and transistors. They play an important part, too, in many processes of modern chemistry and metallurgy; for example, the catalysts that are used in the cracking of crude oil to produce gasoline depend on them for their activity.

### New Use for Radioactive Cobalt

Physicists at the atomic energy research establishment at Harwell, collaborating with timber experts, have found that small doses of radioactive cobalt can halt the reproductive instinct in the death watch beetle and make its eggs infertile. The method they have developed will be used to protect historic buildings and furniture, which are the principal victims attacked by the beetle.

### Magnetic Measurements and Biological Substances

In the last few years, magnetic measurements have been carried out which indicate that it is possible to get some additional information regarding the ionic configuration and the type of binding that exists in some of the complex biological substances such as haemoglobin.

F. Gruen and R. Hass (*Nature*, 1956, 177, 378) have investigated the magnetic properties of vitamin B<sub>12</sub>—the anti-pernicious anemia factor. The substance contains cobalt. The cobalt, apparently, is in a trivalent form since B<sub>12</sub> is diamagnetic. This checks with the hexa-co-ordinated form of the compound as revealed by X-ray investigations.

[For a general description of the behaviour of vitamin B<sub>12</sub> and its structure, see A. W. Johnson and A. Todd, *Endeavour*, 1956, 15, 29.] By following the magnetic measurements through

the various stages of reduction, it is possible to follow the change in the co-ordination and magnetic properties of cobalt, and thus elucidate the behaviour of this rather complicated compound. When only about 150  $\mu$ g. of material is used in the sample tube, the measurements indicate that on reduction the contents become more paramagnetic.

#### Gift of Rare Australian Specimens

Some very rare Australian specimens—skeleton of Kangaroo (articulated and disarticulated), a stuffed specimen and a skeleton of *Platypus*, an *Edentate* skull, a stuffed sp. and skull of *Pseudochirus laniginosus* (female), a stuffed specimen of *Trichosurus vulpecula*: brush-tailed possum with young one in pouch, two Australian bats: *Chalinolobus gouldi* and *Nyctophilus geoffroyi*, and a very beautiful specimen of *Neoceratodus*—have been presented to Fergusson College, Poona-4, by Queensland Museum, Brisbane; National Museum of Victoria, Melbourne, and Government of Australia, through the good offices of Dr. R. P. Paranjape and Dr. D. D. Karve.

#### Fishing Gear Congress

An International Fishing Gear Congress is being planned by the Food and Agriculture Organization to take place in October 1957, in Hamburg, Germany.

The Congress will bring together from many parts of the world specialists working in the field of fish gear research, design and manufacture to discuss such subjects as net yarns, net-making, rational design of fishing gear, including fish detection and the use of electrical equipment.

In connection with the Congress, FAO is compiling a comprehensive *Handbook of Fishing Gear and Methods*, the first of its kind. The book will provide detailed descriptions and specifications of advanced types of fishing gear, equipment and methods, and will give solid background information to the many topics which will be discussed at the Congress.

#### Pre-Natal Diagnosis of Sex

Drs. Leo Sachs, David M. Serr and Mathilde Danon (Israel) report in a recent issue of *Science* (1956, 123, 548) that pre-natal diagnosis of sex can be made before birth, not only for aborted fetuses from which pieces of tissue can be removed for examination, but also for viable fetuses by an examination of cells from the amniotic fluid. In order to establish whether

amniotic fluid contains cells suitable for diagnosis, fluid was taken before delivery by puncture of the membranes from women in the ninth month of pregnancy. The fluid was centrifuged, and the cells were smeared on slides, fixed in alcohol-ether, and stained with Feulgen and fast green. Analysis has shown that cells suitable for the diagnosis are present, and an examination of 35 cases in the ninth month has given 35 correct diagnoses of the sex of the fetus.

Amniotic fluid can be obtained from viable human fetuses from 12 weeks to term. It may be possible to apply this method for the pre-natal diagnosis of sex to domestic animals.

#### High Quality Kerosine

A process to improve the smoke point of kerosine has now been installed by the 2 million ton Burmah-Shell Refinery at Trombay. The principle was originally established by Dr. Edeleanu that liquid sulphur dioxide has the power of extracting selectively the more aromatic compounds which are responsible for the bad illuminating properties of kerosine. This forms the basis of a modern Edeleanu plant which is a highly specialised and complex piece of machinery consisting of a maze of pipes and towers where the undesirable kerosine components are removed by a special extraction treatment with liquid sulphur dioxide. The Edeleanu process thus improves the smoke point and burning qualities and produces a high quality illuminating kerosine for the market.

#### Raptakos Fellowships for Medical Research

The last date for submission of applications for the above Fellowship is 1st September 1956, and not 30th September as announced earlier in this Journal (1956, 25, 208).

#### Award of Research Degree

The University of Madras has awarded the D.Sc. Degree in Biological Chemistry to Shri S. V. Ganapati for his thesis entitled, "Studies on the Sources of the Madras City Water Supply and on Certain Other Waters of the Madras State".

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri Dinkar Damodar Deshpande and Chakrapani Govind Joshi for their theses "Ultrasonic Velocity in Gases and Liquids" and "Lithium Aluminium Hydride as a Reducing Agent for Anthoxanthins".

# Current Science

Vol. XXV]

AUGUST 1956

[No. 8

	PAGE		PAGE
<i>Genetic Effects of Radiation</i> .. ..	243	<i>An Apparatus for the Determination of the Water Requirements of Crops—</i>	
<i>India's First Atomic Reactor</i> .. ..	245	S. PARAMESWARAN .. .. .	250
<i>Stress-Optic Dispersion in Glasses—S. RAMASESHAN AND V. SIVARAMAKRISHNAN</i>	246	<i>Obituary—Dr. E. D. Merrill—D. CHATTERJEE</i> .. .. .	252
<i>Utilization Possibilities of Kashmir Lignite—S. N. WAZIR</i> .. .. .	248	<i>Letters to the Editor</i> .. .. .	253
<i>Calcium Oxalate Crystals as an Index of Nutrient Uptake in the Tea Plant—D. N. BARUA</i> .. .. .	249	<i>Reviews</i> .. .. .	270
		<i>Science Notes and News</i> .. .. .	274

## GENETIC EFFECTS OF RADIATION

ABOUT a year ago, the U.S. Atomic Energy Commission published a report, which stated that as a result of atomic and hydrogen bomb tests, the residents of the United States had received a radiation dose of about 0.1 r. This is about equal to the annual dose due to natural sources, which is certainly appreciable.

This estimate though not very accurate produced a worldwide reaction of anxious interest and in consequence careful enquiries on the long-term effects of nuclear tests were initiated in various countries. Two reports have appeared recently—"The Hazards to Man of Nuclear and Allied Radiations", by the committee set up by the British Medical Council, and "Biological Effects of Radiation" by the Genetics Committee, one of six set up by the U.S. National Academy of Sciences. A report\* on 'Nuclear Explosions and Their Effects' has just been published by the Government of India,

which contains a documented account of various aspects including the biological effects of nuclear tests.

A significant aspect of these reports is the fact that the radiation dosage received by the population of the more industrially advanced countries from sources other than nuclear explosions is itself reaching a danger level. It is fortunate that the committees have examined this wider question, although they were set up for a more specific purpose; for it appears that the dosage from many modern gadgets, such as luminous toys and X-ray shoe fitting machines all add up to the total radiation dosage received by a population. The British Committee in fact states that adequate justification should be required for the employment of any source of ionizing radiation on however small a scale. It has recommended that the maximum exposure for any one person should not exceed 0.3 r. per week, and that during his whole life-time an individual should not be allowed to accumulate more than 200 r. of "whole-body" radiation, in addition to that received from the natural background, and that this allowance should be spread over tens of years. An individual should not be allowed to

\* This comprehensive, semi-popular report based on published data has been prepared under the supervision of Dr. D. S. Kothari of the Defence Science Organisation, and contains a Foreword by the Prime Minister, Sri. Jawaharlal Nehru. It is available from the Publications Division, Ministry of Information and Broadcasting, Government of India, Delhi 8, Price Rs. 3/8.



accumulate more than 50 r. of radiation to the gonads, in addition to that received from the natural background, from conception to the age of 30 years; and this allowance should not apply to more than one-fiftieth of the total population.

The present and foreseeable hazards from external radiation due to fall-out from the test explosions of nuclear weapons, fired at the present rate and in the present proportion of the different kinds, would seem to be negligible. The estimate is about 1% of the natural background, which amounts to 0.1 r. per year. This is however on the basis that a person spends only about 2½ hours per day out of doors, and that the screening by the walls of buildings produces a large factor of safety at other times.

Account must be taken, however, of the internal radiation from the radioactive strontium which is beginning to accumulate in bone. At its present level no detectable increase in the incidence of ill-effects is to be expected. Nevertheless, recognizing all the inadequacy of our present knowledge, we cannot ignore the possibility that, if the rate of firing increases, and particularly if greater numbers of thermonuclear weapons are used, we could, within the life-time of some now living, be approaching levels at which ill-effects might be produced in a small number of the population.

As to the actual genetic effects which are likely to be produced by the increased amount of radiation, the findings are not so definite. The American report distinguishes between imminent danger to individuals and more remote trouble that may be experienced by very large numbers of persons in the far distant future. The latter has been much stressed in an article by Haldane which appeared in this Journal a few months ago (1955, 24, 399). A small but not negligible part of the harm done by radiation-induced mutations would appear in the first generation of the offspring of the person who received the radiation. Most of the harm, however, would remain unnoticed for a shorter or longer time in the genetic constitution of the successive generations of offspring. But the harm would persist and some would be expressed in each generation.

The report states that any radiation dose, however small, can induce some mutations. "The concept of a safe rate of radiation simply does not make sense if one is concerned with genetic damage to future generations. What counts, from the point of view of genetic damage, is not the rate; it is the total accumulated dose to the reproductive cells of the in-

dividual from the beginning of his life up to the time the child is conceived."

The possibility is mentioned that increased and prolonged radiation might so raise the death rate and lower the birth rate that the population would decline and eventually perish. But there is much uncertainty as to the level of this fatal threshold for a human population. "This is one reason why we must be cautious about increasing the total amount of radiation to which the entire population is exposed."

In its concluding comments the report draws attention to the fact that the present state of advance in atomic and nuclear physics on the one hand and in genetics on the other is seriously out of balance. "We badly need to know much more about genetics... our society should take prompt steps to see to it that the support of research in genetics is substantially expanded and that it is stabilized."

Although there is thus no cause for alarm of any large increase in the level of radiation from nuclear test fall-outs, it is significant that the reports have pointed out the comparatively large level of radiation received by persons undergoing X-ray examination, or wearing luminous dial wrist watches. This is very well illustrated in Chart IV of the manual published by the D.S.O. An airplane pilot receives from the dials of his instrument board a dosage of about 1.3 r. per year, nearly ten times the natural dosage. The alarming gonadal dosage received by the population from the medical use of X-rays has been commented upon in the U.S. report. It is important that this aspect of radiation effects from non-nuclear test sources should have much wider publicity and should receive careful consideration.

Neither the British nor the American report has made any statement as to whether the tests of atomic weapons should continue or not. However, judging from the gravity which they attach to the hazards from other sources of radiation, there is no doubt as to the pointer. On the other hand, no one can disagree with the following concluding statement of the D.S.O. report: "While no one with any understanding of problems of nuclear war has argued that a war with nuclear weapons would be anything less than a total disaster, there are some who argue that tests can continue, because it is not yet firmly established that, on the present scale, they would lead to any substantial increase in the existing somatic and genetic load of mankind. In effect, this means that tests can continue so long as it is not known with certainty that they would cause

serious harm to man. This is a rather strange line of argument. To argue that tests should stop only if it were definitely established that their continuation would bring *certain* disaster to mankind, is a regrettable commentary on 2,500 years of progress since the Buddha. In

fact, there can be no doubt at all that if civilization is to endure and progress, what is now necessary—and desperately so—is that the new knowledge of the atom, instead of being mobilized for weapons and war, should be mobilized in the cause of peace and plenty”.

### INDIA'S FIRST ATOMIC REACTOR

INDIA'S first atomic reactor at Trombay became critical and went into operation at 3-45 p.m. on August 4. This may be said to be a landmark in the development of atomic energy for peaceful purposes in this country.

The decision to build this reactor was taken by the Atomic Energy Commission at its meeting on March 15, 1955. Various different designs for the shape of the pool and the experimental facilities were discussed by a committee consisting of Mr. Prasad, Dr. Ramanna, Mr. Rao and Dr. Singwi. Two possible designs for the pool were considered, one in which the reactor moves horizontally in a rectangular tank, and the other in which it moves in a vertical cylindrical well. The possibility of combining horizontal and vertical movements was also considered. It was finally decided to adopt the design with horizontal motion, as this provided the diverse experimental facilities which were needed for this reactor.

The reactor, which is housed in a hall 100' long, 50' wide and 70' high, is of the swimming pool type, and consists of a rectangular concrete tank 28' x 10' and 28' deep, with massive concrete walls 8½' thick. The reactor is immersed in this pool of water, hence the description 'swimming pool type'.

The core of the reactor is approximately a cube of 2' side, which is suspended by a rigid frame from a trolley above, which moves on rails mounted on the sides of the pool. The core consists of from 25 to 30 fuel elements containing the fissile material uranium 235 in the form of a sandwich. Each thin plate of uranium 235 aluminium alloy is sandwiched between two plates of aluminium. The fuel elements can be removed or placed in position by long aluminium rods operated from the trolley above.

When in operation, the fuel elements generate heat through fission, and are cooled by the water, which also acts as a 'moderator' for slowing down neutrons, and provides the necessary protection to the personnel against radiation. The reactor is provided with a number of automatic safety devices, which shut it down in a fraction of a second if one of a number of danger signs appears. For

example, it will shut down if the electric power fails, or excessive heat is generated, or certain instruments fail. The reactor is of a type described as inherently safe. Even if all the automatic controls were to fail, and the reactor were to 'run away', the excessive generation of heat would convert the water into steam, and the reactor would automatically shut down, because there would be no water left to slow down the neutrons.

The concrete shield is pierced by a number of holes, known as experimental channels, which extend towards the core of the reactor. Neutrons flow down these channels from the core to be used for experiments. In these experimental channels materials can be placed for irradiation and later studied for the effects of radiation. Radio-isotopes can also be produced.

In addition to the experimental channels, there is, at one end of the reactor, an opening 6' square, known as the thermal column, filled with graphite blocks of nuclear purity, which contain less than half a part per million of boron. At the other end of the reactor, facilities have been provided for shielding experiments. At this point the 8' thick concrete shield is replaced by a 2" aluminium wall behind which the concrete blocks are mounted on heavy trolleys. When the protective properties of some material is to be tested, the blocks are replaced by this material and the reactor is moved against the aluminium wall. The information so obtained is of use in designing shielding materials for more advanced types of reactors.

The reactor will be used for training personnel for the bigger and more complicated reactors, which are to come, for experiments in physics and for making radioactive isotopes for research in agriculture, industry and medicine. India will make the facilities of this reactor available to scientists of countries in this region and beyond.

The fuel elements for the reactor were provided by the United Kingdom under an agreement signed in October last year between the United Kingdom Atomic Energy Authority and the Department of Atomic Energy.

## STRESS-OPTIC DISPERSION IN GLASSES

S. RAMASESHAN AND V. SIVARAMAKRISHNAN

Dept. of Physics, Indian Institute of Science, Bangalore-3

WHILE examining the data acquired recently by the authors on the dispersion of the stress-optic coefficient (s.o.c.) in a series of optical glasses, it was noticed that there existed no satisfactory theory on this subject for explaining the experimental results. This communication presents the phenomenological theory of stress-optic dispersion (s.o.d.) and develops a formula for the same. The data for fused silica (Filon)<sup>1</sup> and those obtained for a typical light glass have been used to verify the essential features of the theory.

## GENERAL THEORY

The stress-optic coefficient<sup>2</sup> is given by the expression  $B = (n_{\parallel} - n_{\perp})/p$ , where  $n_{\parallel}$  and  $n_{\perp}$  are the refractive indices of the stressed isotropic solid for light polarised parallel and perpendicular to the direction of stress. The magnitude of  $n_{\parallel} - n_{\perp}$  can be easily obtained from the dispersion formula for the substance. In general, the effect of stress on a solid would be very similar to that of either a magnetic field<sup>3</sup> or temperature,<sup>4,5</sup> i.e., to affect the three parameters,  $N_1$  the number,  $f_1$  the oscillator strength and  $\nu_1$  the frequency of the dispersion electron. If one, therefore, starts with a dispersion formula of the Drude type

$$n^2 - 1 = \sum_1^s \frac{A_1 N_1 f_1}{\nu_1^2 - \nu^2} \quad (1)$$

then

$$\begin{aligned} \frac{\Delta n_{\parallel}}{\Delta p} = \frac{1}{2n} \sum_1^s \left\{ - \frac{2A_1 N_1 f_1 \nu_1^2}{(\nu_1^2 - \nu^2)^2} \left[ \frac{1}{\nu_1} \frac{\partial \nu_1}{\partial p} \right]_{\parallel} \right. \\ \left. + \frac{A_1 N_1 f_1}{\nu_1^2 - \nu^2} \left[ \frac{1}{f_1} \frac{\partial f_1}{\partial p} \right]_{\parallel} \right. \\ \left. + \frac{A_1 N_1 f_1}{\nu_1^2 - \nu^2} \left[ \frac{1}{N_1} \frac{\partial N_1}{\partial p} \right]_{\parallel} \right\} \quad (2) \end{aligned}$$

and one also has a similar expression for  $\Delta n_{\perp}$ . If one substitutes

$$K_1' = \left[ \frac{1}{\nu_1} \frac{\partial \nu_1}{\partial p} \right]_{\parallel} - \left[ \frac{1}{\nu_1} \frac{\partial \nu_1}{\partial p} \right]_{\perp}$$

and  $K_1''$  and  $K_1'''$  for corresponding functions for the oscillator strength and the number of oscillators then

$$\begin{aligned} B = \frac{n_{\parallel} - n_{\perp}}{p} = \frac{1}{2n} \sum_1^s \left\{ - \frac{2K_1' A_1 N_1 f_1 \nu_1^2}{(\nu_1^2 - \nu^2)^2} \right. \\ \left. + K_1'' \frac{A_1 N_1 f_1}{\nu_1^2 - \nu^2} \right. \\ \left. + K_1''' \frac{A_1 N_1 f_1}{\nu_1^2 - \nu^2} \right\} \quad (3) \end{aligned}$$

Since in equation (1) the sum of the transition probabilities must necessarily be equal to unity, i.e.,  $\sum f_1 = N$  it follows that in equation (2)  $\sum \Delta f_1 = 0$  and therefore in equation (3).

$$\sum K_1'' f_1 = 0 \quad (4)$$

Hence if the dispersion formula (1) is written as

$$n^2 - 1 = \sum_1^s \frac{C_1 \lambda_1^2 \lambda^2}{\lambda^2 - \lambda_1^2} \quad (5)$$

then the formula for stress-optic dispersion would be

$$B = \frac{1}{n} \sum_1^s \left[ \frac{P_1 C_1 \lambda_1^2 \lambda^4}{(\lambda^2 - \lambda_1^2)^2} + \frac{Q_1 C_1 \lambda_1^2 \lambda^2}{\lambda^2 - \lambda_1^2} \right] \quad (6)$$

where

$$\sum Q_1 C_1 = 0 \quad (7)$$

The first term (P term) represents the effect of the frequency change and second term (Q term) gives the effect due to change in the strength of the oscillators. For testing out these formulæ it is, therefore, necessary not only to have accurate data of the stress optic coefficient of a substance over a wide range of wavelengths but also to have its refractive indices analysed into an accurate dispersion formula that makes use of experimentally observed absorption frequencies.

## VERIFICATION OF THE THEORY

The substances chosen for verification of this formula are fused silica and a typical crown glass. For fused quartz an accurate dispersion formula using two experimentally observed frequencies at 1190 Å and 1060 Å and a hypothetical one at 600 Å is available.<sup>6</sup> A two-term dispersion formula for the glass was constructed with the absorption wavelength at  $\lambda$  600 and  $\lambda$  1077 which fits the experimental data on refraction to five units in the fifth place of decimals. The dispersion formulæ for the two substances are as follows:

$$\begin{aligned} n^2 - 1 = \frac{0.1570\lambda^2}{\lambda^2 - (0.1190)^2} + \frac{0.4151\lambda^2}{\lambda^2 - (0.1060)^2} \\ + \frac{0.5320\lambda^2}{\lambda^2 - (0.0600)^2} + \frac{0.4538\lambda^2}{\lambda^2 - (8.84)^2} \\ + \frac{1.4460\lambda^2}{\lambda^2 - (20.74)^2} \quad (\text{fused silica}). \end{aligned}$$

$$\begin{aligned} n^2 - 1 = \frac{0.85192\lambda^2}{\lambda^2 - (0.1077)^2} + \frac{0.3935\lambda^2}{\lambda^2 - (0.0600)^2} \\ (\text{Glass No. B.S.C. 510644}). \end{aligned}$$

The values of the s.o.c. for fused silica were obtained from a smooth curve drawn through the various values given by Filon<sup>1</sup> for different wavelengths. The s.o.c.'s for the glass were obtained by a magneto-optic method<sup>7,8</sup> developed in this laboratory.

It was first noticed that by using  $Q$  terms alone (Eqn. 6) with the condition (7) imposed, it was not possible to fit the experimental data, indicating most clearly that there does exist a frequency change when a solid is stressed. Further it was found that if one assumed that  $P$  is the same for all the frequencies, a formula with  $P$  terms only did not satisfy the experimental data. There is no doubt therefore that both frequency and transition probability changes have to be taken into account. There are now 6 parameters to be altered and one could always by a judicious variation of these, bring about a fit between the experimental and calculated values. The following reasonable assumptions have been made so that the number of parameters to be altered is reduced considerably: (a) values  $P$  and  $Q$  for  $\lambda$  1190 and  $\lambda$  1060 are the same, (b) the absorption wavelength at 600 Å being due to inner levels is not split by the pressure. Using these two conditions and that given in Eqn. (7) the values of the s.o.c. for different wavelengths for fused silica and the crown glass have been calculated. It must be noticed due to condition (7) the sign of  $Q$  (600) is negative, while for the other absorption wavelengths it is positive. The observed and calculated values have been entered in Tables I and II. The agreement between them is quite satisfactory. The  $P$  and  $Q$  values for different wavelengths have also been given.

TABLE I

Substance	Wavelength in Å	Stress-optic coefficients (in brewsters)	
		Calculated	Experimental
Fused Silica	6500	3.56	3.56
	6000	3.59	3.59
	5500	3.63	3.63
	5000	3.68	3.68
	4700	3.72	3.72
Glass*	5461	2.67	2.67
	4916	2.71	2.74
	4358	2.77	2.77
	4047	2.81	2.81

\* B.S.C. Type— $\text{SiO}_2$ —69.6%;  $\text{B}_2\text{O}_3$ —6.7%;  $\text{K}_2\text{O}$ —20.5%;  $\text{CaO}$ —2.9%.

TABLE II

Values of  $P$  and  $Q$ , all in units of  $10^{-13}$

Substance	$P_1$	$P_2$	$P_3$	$Q_1$	$Q_2$	$Q_3$
Fused Silica	6.704	6.704	0	1.451	1.451	— .4782
Glass	2.800	..	0	2.355	..	—1.588

One is, therefore, forced to conclude that the stress-optic dispersion arises due to both a frequency shift and a change in the oscillator strength caused by strain. For unidirectional stress, which is the case under discussion, due to opposite strains parallel and perpendicular to the stress, the absorption frequency (as in the case of a magnetic field) would split into two, one of the components being responsible for the dispersion of light polarised parallel to the direction of stress, the other for light polarised in a direction perpendicular to it. Such changes in the frequency due to stress have been conceived of by earlier workers (G. N. Ramachandran<sup>9</sup> and Burstein<sup>10</sup>) and has actually been experimentally observed in Raman effect studies by Marie and Mathieu<sup>11</sup> in the case of quartz. The extension of this theory to cubic and anisotropic crystals is obvious. It is also evident that this theory is not applicable to the cases where there is a realignment of molecules due to stress. Such a phenomenon is known to occur in high polymers and substances containing long chain molecules. In such cases new dispersion frequencies have to be invoked to explain the dispersion.

#### RELATION TO CHANGES IN POLARISABILITY

A change in the density of the substance causes a variation of the Lorentz polarisation field inside it, which in its turn alters both the frequency and the transition probability of the dispersion electron. Mueller<sup>2,12</sup> has shown that the stress-optic effect cannot just be considered as due to changes in the Lorentz polarisation field caused by an increase in density in one direction and a simultaneous decrease in the perpendicular direction. He has also demonstrated that as the birefringence obtained by such a hypothesis would be opposite to that observed in most substances, it is essential to assume that the strain actually alters the polarisability of the atoms. The changes in the oscillator characteristics induced by density changes would, therefore, be opposite to those due to these "strain polarisability" effects.

Many of the phenomena observed in glasses can be explained if one assumes that while the atoms that actually take part in the "network" like O, Si, Al, etc., suffer changes in the polarisability due to strain and are also affected considerably by the changes in the Lorentz field, the ions like Na, K, Pb which occupy the holes in the "network"<sup>13</sup> are not particularly susceptible to the former polarisability changes but are affected to a larger extent by the alterations in the density of the surrounding atoms. Hence the introduction of such ions into the silica network would tend to decrease the s.o.c. of the glass. The absorption wavelengths of many of these heavier ions are much greater than those for the network forming atoms. Hence the dispersion of the negative effect would tend to mask the dispersion arising from strain polarisability changes. One could, therefore, easily conceive of glasses with a fair percentage of heavy ions having stress-optic coefficients which practically do not show any dispersion or exhibiting even negative dispersion (i.e., the s.o.c. decreasing with decreasing wavelength). As the ratio of the heavier ions continues to increase, one should expect to find the s.o.c. actually becoming zero for a particular wavelength and then changing sign.

Many of these phenomena have been observed in glasses. It has also been noticed that most glasses show a small increase in the s.o.c. at  $\lambda 4916$  and a tendency to decrease at  $\lambda 3650$ . Investigations are in progress to find out if these anomalies are real and if so whether they have any relationship to the fluorescent bands that are usually found in these regions.

The authors wish to thank Dr. S. Chandrasekhar, Dr. K. Vedam and Prof. R. S. Krishnan for the many discussions they had with them.

1. Filon, L. N., *Proc. Roy. Soc.*, 1931, **130 A**, 410.
2. Mueller, H., *Physics*, 1935, **6**, 179.
3. Schutz, W., *Handbuch der Experimental Physik*, **16**, Magneto-Optik.
4. Ramachandran, G. N., *Proc. Ind. Acad. Sci.*, 1947, **25 A**, 266.
5. Chandrasekhar, S., *Ibid.*, 1954, **29**, 290.
6. —, *Ibid.*, 1951, **34**, 235.
7. Ramaseshan, S. and Chandrasekharan, V., *Curr. Sci.*, 1951, **20**, 150.
8. Ramaseshan, S., *Proc. Ind. Acad. Sci.*, 1954, **40 A**, 184.
9. Ramachandran, G. N., *Ibid.*, 1947, **25 A**, 208.
10. Burstein, E. and Smith, P., *Ibid.*, 1948, **28**, 377.
11. Marie and Mathieu, J.-P., *Compt. Rend. Acad. Sci.*, 1946, **223**, 147.
12. Mueller, H., *J. Ceramic Soc.*, 1938, **21**, 27.
13. Warren, B. E., *Z. Krist.*, 1933, **86**, 349.

## UTILIZATION POSSIBILITIES OF KASHMIR LIGNITE

LIGNITE deposits in Kashmir Province have been estimated at 128 million tons, of which 48 million tons are in the Shaliganga area (Raithan and Lanyalab) and 80 million tons in the Nichahoma area. The unestimated but proved deposits are however many times higher.

So far it has not been possible to use this lignite on account of its poor quality, for, Kashmir Lignite is difficult to be ignited because of its high inert content. Once ignited, it is also difficult to maintain a constant fuel bed temperature because of the speedy evolution of volatiles leaving behind insufficient fixed carbon to maintain the bed temperature. Besides, burning of lignite in open grates results in smoke and smell, a nuisance which for

long has stood in the way of its utilization. This is due to incomplete combustion of volatiles which escape unburnt.

However, some useful results have been achieved towards its utilisation by the Industrial Research Laboratory, Srinagar. It has been found that Kashmir lignite in the immediate future can be used in its raw form in specially designed ovens, stoves and furnaces. It can also be subjected to pressure gassification for town gas supply and fertilizer manufacture. In this process liquid by-products will be available in addition. Lignite may also be used in pulverised form for thermal power generation.

Indus. Res. Lab.,  
Srinagar.

S. N. WAZIR.

# CALCIUM OXALATE CRYSTALS AS AN INDEX OF NUTRIENT UPTAKE IN THE TEA PLANT

D. N. BARUA

Tocklai Experimental Station, I.T.A. Scientific Department, Cinnamara, Assam

IN a previous communication<sup>1</sup> it was shown that the frequency of calcium oxalate crystals in the tea plant (*Camellia sinensis* L.) differs between clones and between populations raised from distinct seed sources (*jats*). A standard crystal count was called *Phloem Index*: this was considered to be indicative of the K/P balance of the tea plant. It was further shown that regeneration of shoots in response to plucking is related to phloem index.

Subsequently, leaf-stalk injection described by Roach<sup>2</sup> was used to study change of crystal frequency caused by nutrients injected into the vascular system. Growing shoots on unplucked bushes were used. The apex of these shoots is a compact structure from which leaves unfold at intervals. On a growing shoot, the leaf wrapped around the apex and the four unfolded leaves below this are increasing in area.

Preliminary observations were made on the movement of dye from one leaf to another. Fully expanded leaves in various positions on the stem were injected with 0.25% acid fuchin. Tea has a 2/5 phyllotaxis. The dye permeated the second and third leaves above and below the one injected. The fifth leaf above injection point was sometimes permeated, possibly when a large amount of dye was taken in by the injected leaf. The pattern of distribution of the injected dye was the same as that observed by Roach<sup>2</sup> in Pear (with the same phyllotaxis as tea).

Roach<sup>2</sup> found dye permeation to increase in proportion to reduction in size of the leaf used for injection. In our work a larger volume of solution might have been injected by using a shorter basal piece of leaf, but it was difficult to work speedily with less than one-third of the mid-rib *plus* petiole and this length (approximately 1.0"), therefore, was used throughout the experiment.

When the third, immature, leaf below the apex of a tea shoot was injected, then dye permeated only the second leaf above and below injection point, but some colouration was seen in the upper third leaf which was wrapped around the apex at the time of injection.

The third leaf below the apex was used for nutrient injection. The lamina of the basal one-third of this was trimmed and the remaining stalk immersed in solution contained in a glass vial (3/8" x 2") between 10 a.m. and

1 p.m. (local time) on 10th October 1955. Vials were removed at 10 a.m. on the following day.

Petioles of the second and third leaves above injection point were used for crystal counts. These leaves had well-developed vascular tissue on the date of injection and were respectively 20 to 25 days short of attaining their maximum area (approximately). Crystal counts were made 6 weeks after injection.

Three bushes in each of four clones were used, all the bushes being contained in an area of approximately 50' x 50'. Ten shoots on each bush were selected for injection, two for each nutrient solution and two for controls. The nutrients, in distilled water, were as follows:

Urea .. .. .	0.25%
Potassium sulphate .. .. .	0.25%
Calcium chloride (2 H <sub>2</sub> O) .. .. .	0.25%
Distilled water.	

Concentrations of potassium sulphate and calcium chloride higher than the foregoing caused a marginal necrosis resembling the condition commonly known as "rim blight": this is considered to be a metabolic disturbance. "Rim blight" can be induced by inorganic manures applied during early stages of shoot growth following pruning. In this connection it is to be noted that potassium sulphate used as a fertiliser can induce more rim blight than ammonium sulphate.

The analysis of variance of phloem index is given in Table I and results for treatments,

TABLE I  
Analysis of variance of phloem index

Source of variance	D.F.	Mean square	F.
Between clones ..	3	52932.9	130.75†
Within clones ..	8	404.8	
Bushes ..	11	14730.7	
Treatments (nutrients) ..	4	1969.4	8.03†
Bush x treatment ..	44	245.3	
Leaf position ..	1	1230.5	4.97†
Position x treatment ..	4	317.4	
Remainder ..	165	247.7	
Total ..	229*		

\* Degrees of freedom adjusted for missing values;  
† Significant at 5% level; ‡ Significant at 0.1% level.  
clones and leaves, in Tables II to IV. In the concentrations used for injection, urea and

potassium sulphate reduced the crystal frequency to less than that of untreated leaves. Crystal frequency did not differ between untreated leaves, leaves injected with water, and leaves injected with calcium chloride. In confirmation of previous observations, a limited range of crystal frequency was found to be characteristic of a particular clone.

TABLE II  
Mean phloem index for treatments

Urea	..	69.7
Potassium sulphate	..	73.7
Calcium chloride	..	82.5
Distilled water	..	81.3
Control	..	85.5

Difference required for significance ( $P = 0.05$ ) : 6.8

TABLE III  
Mean phloem index for clones

Clone	Phloem Index
16/10/22	.. 90.0
19/19/8	.. 73.5
19/10/3	.. 112.8
19/27/11	.. 41.1

Difference required for significance ( $P = 0.05$ ) : 8.8

TABLE IV  
Mean phloem index for leaves

2nd leaf	3rd leaf
76.3	81.0

Difference required for significance ( $P = 0.05$ ) : 4.1

Injected urea, and ammonium<sup>1</sup> applied to the soil<sup>1</sup> both reduced frequency, from which it can be predicted uptake of certain nutrients by the plant. To determine crystal frequency within limits. Crystal frequency, therefore, may be a sensitive quantitative index of changes associated with nutrient uptake. It could be used to investigate the relation of tea plant to environment. When a clone has a constant crystal frequency at several locations then a difference between frequency caused by injection and frequency caused by application of nutrient to the soil may alter with time, so indicate soil variation of importance to growth of the tea plant. The nutrients for the cultivation of tea are likely to be that when injected cause a reduction in frequency.

The author is indebted to Dr. W. V. Mr. E. Hainsworth for suggesting the investigation, and to the Director of the Indian Tea Association for permission to publish this paper.

1. Wight, W. and Barua, D. N., *Curr. Sci.* 78.

2. Roach, W. A., "Plant injections for diagnostic purposes," *Imp. Bureau of Plantation Crops Tech. Comm.* No. 101

AN APPARATUS FOR THE DETERMINATION OF THE WATER REQUIREMENTS OF CROPS

S. PARAMESWARAN

Division of Agricultural Meteorology, Poona-5

THIS article describes how the exact measurement of the water losses by transpiration from crops, evaporation from the soil, etc., may be made, employing an electronic technique.

The amount of water required by a growing crop depends upon the soil as well as the plant itself. The plant, of course, transpires water and thus contributes to a certain extent to the loss of water. In addition, an appreciable amount of water is also lost due to evaporation, etc., from the soil and this loss depends upon the type of soil. Though the loss of water due to these two factors is large, and thus seemingly easy of exact measurement, it should be noted that this is very small compared with the weight of the soil itself, which

is unavoidably large. The measurement of change in weight represented by the loss of water from a large mass of soil proved a difficult problem.

It should also be borne in mind that the continuous recording of the loss of water during the day. An apparatus that accomplishes this without any complexity can be adapted for continuous recording. The method, well, is described below.

PRINCIPLE

The underlying principle of the method is the annulling effect of the dead weight of the soil through a process of equilibrium of suitable counterweights and the effect of the superimposed small changes

into corresponding displacements. The development of the apparatus for accurate measurements of small displacements by transduction into electrical signals can be traced over a past few years. So far, the most widely used method is the one that converts these small displacements into strains in a wire that forms one arm of a balanced Wheatstone bridge. The strain in the wire increases the resistance of the wire. This method, however, suffers from the disadvantage that the susceptibility of resistances to temperature variations is a disturbing factor.

There is also a method in which the small displacements is converted into a change of inductance or capacitance of a parallel resonant circuit and thus a change in the resonance frequency. This method is superior to the other method since it is less subject to temperature variations and is more stable. In the method used here, the small displacements change both the inductance and capacitance in the same direction thus taking advantage of the cumulative effect of these to change the resonance frequency instead of one single parameter, thus increasing the sensitivity of the equipment.

#### THE APPARATUS

Two soil tanks, each approximately  $2' \times 2' \times 2'$ , are balanced on a platform with lever arrangements as in a weighing machine. The counterweights are first adjusted to balance out the dead weight of the soil. This is indicated by the lever remaining in a horizontal position. Any changes in weight are indicated by the lever moving up or down from its initial horizontal position. From the right end of the lever are suspended the movable plate of an air condenser and the core of an inductance, the former to convert small displacements into changes of capacitance and the latter into changes of inductance. The inductance and capacitance form the tuned circuit of an oscillator. The oscillator is stabilized and adjusted to give a frequency of about 50 kc. The plate voltage is derived from a regulated D.C. source to avoid any spurious changes in frequency. Precautions are taken to avoid the capacitance due to leads, etc. The changes in the inductance and capacitance produce a change in the frequency of the oscillator. The output of the oscillator is then fed to a buffer amplifier so as to avoid the otherwise inevitable effects of the changes in load on the frequency. The buffer amplifier is operated in

Class A, so that it draws no grid current and thus minimises any changes in the load of the oscillator. The output of the buffer amplifier is connected to an electronic frequency meter designed to measure frequency very accurately. It is an easy matter to calibrate the equipment so that changes in weights can be given directly in terms of changes in frequency from the resonance frequency.

The equipment can be adapted for continuous recording by feeding the output from the frequency meter to a recording milliammeter after D.C. amplification.

The equipment has been tested and found to be satisfactory. The sensitivity of the equipment was sufficient to enable measurement of changes in weight of the order of 2 oz. in a total weight of 1 ton. The maximum change in weight that can be measured at one time is designed to be 3 lb. after which the counterweights have to be adjusted to bring the lever to a horizontal position. One lb. change in weight is adjusted to give a change in the frequency of 2.5 kc.

The equipment has also been tried in the field and found to work satisfactorily.

By using the above instrument evapo-transpiration for Jowar grown in tanks has been determined. Jowar seeds were sown in the experimental tanks on 10th July 1955. The daily evaporation from only the soil in both the tanks just before the sowing of the crop was found to be 0.047". During the growth of the crop the loss of water from the soil as well as from the plant was determined daily and plotted in the form of a graph. To supplement any rainfall, the crops were irrigated

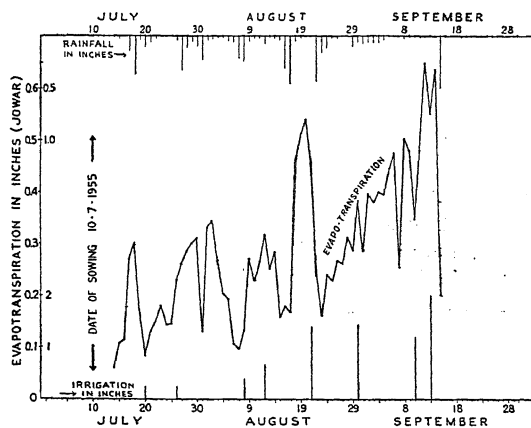


FIG. 1



from the top from time to time. The daily loss of water by evapo-transpiration obtained by the electronic equipment agreed fairly well with that obtained with weighing machine. The daily loss of water by evapo-transpiration only is shown in Fig. 1 from 10th July to 15th September 1955, after which the crop experienced frequent heavy rains and the crop got lodged.

The total loss of water by evapo-transpiration from the date of sowing to 15th September 1955, was 18.38". The approximate height of the crop on the given dates are given below:

Date	Approximate height of the crop
13-7-1955	½"
30-7-1955	6"
15-8-1955	11"
31-8-1955	2' 7"
15-9-1955	3' 4"

Investigations are still in progress and fuller details will be published elsewhere. Thanks are due to Dr. L. A. Ramdas and Shri S. P. Venkiteshwaran for their valuable guidance in this work.

## OBITUARY

### DR. E. D. MERRILL

DR. ELMER DREW MERRILL, Sc.D., LL.D., Arnold Professor of Botany, Harvard University, and Retired Director of the Arnold Arboretum, Mass., U.S.A., passed away at Jamaica Plain, Mass., U.S.A., on the 25th February 1956. He was 79.

Dr. Merrill was among the foremost of American botanists and held a position in the international field unrivalled till his death. From a modest beginning as an Assistant in the Department of Natural Science, University of Maine and later as Botanist in the Bureau of Agriculture and Forestry, Manila, Merrill rose to the post of Director, New York Botanical Garden (1930-35) and later as Director, Arnold Arboretum and Arnold Professor of Harvard University. For more than fifty years (1904-55) Merrill's numerous publications covered a large number of subjects and he described plants from many lands. Most noteworthy among these are his authoritative work on the Philippines Plants, Guam Plants, Bornean Plants, Chinese Plants, other Pacific Island Plants and Botanical nomenclature. He was an acknowledged authority in all these subjects, especially in botanical nomenclature. His contributions to this subject can also be compared favourably with Linnaeus, whose work of codification of plant names current in his time was a landmark in botanical science.

Merrill has published nearly three hundred

scientific papers, several scores of new genera and some three thousand new species and new combinations. Some of Merrill's important works are: *Flora of Manilla* (1911), *An Interpretation of Rumphias' Herbarium Amboinense* (1917), *Species Blancoanæ* (1918), *Enumeration of Philippine Flowering Plants* (1926), *Commentary on Loureiro's Flora Cochinchinensis* (1935), *A Bibliography of Eastern Asiatic Botany* (with Dr. E. H. Walker) (1938), *Plant Life of the Pacific World* (1945) and *Botany of Cook's Voyages* (1954).

Many species and genera have been named after him, among which may be mentioned *Merrillioanax* Li, *Merrillia* Swingle, *Merrillanthus* Chung et Tsiang, and *Merrilliyobryum* Broth. He was a recipient of many honours, and a corresponding member of many foreign societies.

Dr. Merrill was a great believer in international co-operation amongst scientists and the present author had the good fortune of meeting him on a few occasions both in England and Holland.

On the occasion of his seventieth birthday the *Chronica Botanica* published a special volume entitled *Merrilliana* containing reprints of his selected writings, which is perhaps the finest tribute that could be paid to one whose life and work has left a veritable landmark in the field of botany.

D. CHATTERJEE.

## LETTERS TO THE EDITOR

	PAGE		PAGE
<i>Some New Bands of Boron Monoxide—</i>		<i>Synthesis of an Analogue of Papavarine—</i>	
N. R. TAWDE AND M. R. KATTI ..	253	T. K. GOVINDAN .. .. .	262
<i>Auditory Reaction Time as a Function of</i>		<i>The Relation of Ascorbic Acid to Fusa-</i>	
<i>Frequency of the Signal Tone—M. S.</i>		<i>rium Wilt in Linseed—JAYENDRA G.</i>	
PRAKASH RAO AND N. A. NAYAK ..	255	BHATT .. .. .	262
<i>The Absorption Spectrum of Uranyl</i>		<i>Effect of Halogen-Ion Concentration on</i>	
<i>Nitrate in Aqueous Solutions—D. D.</i>		<i>Milk Coagulation by Pepsin—S. D.</i>	
PANT AND D. P. KHANDELWAL ..	255	PISHAWIKAR AND D. N. KAMAT ..	263
<i>New Emission Spectrum of Bromine in</i>		<i>Placentation in Melia azadirachta Linn.</i>	
<i>the Far and Vacuum Ultraviolet—</i>		<i>(Azadirachta indica Juss.)—N. C. NAIR</i>	264
P. B. V. HARANATH AND P. TIRUVENGANNA		<i>Response of Sugarcane to Sulphanilamide</i>	
RAO .. .. .	256	—M. S. SUBBA RAO, R. S. PRASAD AND	
<i>Optical Behaviour of Iridescent Sodium</i>		K. L. KHANNA .. .. .	265
<i>Nitrate Crystals—A. K. RAMDAS ..</i>	257	<i>Mode of Feeding by Pyrilla—J. L. WAKH-</i>	
<i>Ferric Ammonium Paramolybdate—</i>		LOO, S. L. SHARMA AND K. L. KHANNA	265
D. V. RAMANA RAO .. .. .	258	<i>Pseudonapomyza atra Meigen (?) on</i>	
<i>A Rapid Procedure for the Estimation of</i>		<i>Paddy—M. Q. KHAN, D. V. MURTHY</i>	
<i>Available Nitrogen in Soils—B. V.</i>		AND A. S. RAO .. .. .	266
SUBBIAH AND G. L. ASIJA .. .. .	259	<i>A New Species of Cercospora on an</i>	
<i>Absence of True Vitamin B<sub>12</sub> Activity of</i>		<i>Economic Host—P. P. CHIDDAWAR ..</i>	267
<i>Pulses—M. RAMACHANDRAN AND S. V.</i>		<i>Meiotic Studies in Adiantum peruvianum</i>	
PHANSALKAR .. .. .	260	Klotz.—R. P. ROY AND BAXI M. B. SINHA	268
<i>Raman Spectrum of m-Fluorobromo-</i>		<i>Chromosome Number of a Pigmented</i>	
<i>benzene—S. L. N. G. KRISHNAMACHARI ..</i>	260	<i>Annona squamosa L.—M. S. PAWAR,</i>	
<i>Steroids in Human Smegma—V. B. KAMAT,</i>		D. S. BORGAONKAR AND S. A. KULKARNI	269
T. B. PANSE AND V. R. KHANOLKAR ..	261		

SOME NEW BANDS OF BORON  
MONOXIDE

WHILE doing some investigations on the boron monoxide bands, we excited the spectrum in various sources to obtain the known  $\alpha$ ,  $\beta$  and the combination systems of the molecule. The bands were excited in arc and flames and were also tried in a discharge. In the arc and in the flame, we could detect the three sequences of discrete bands accompanying the fluctuation bands, first observed by N. L. Singh<sup>1</sup> and ascribed by him to the transition  $C^2\Sigma \rightarrow B^2\Sigma$  of  $B^{11}O$  molecule.

When we tried to excite the bands in discharge with  $BCl_3$  vapour, we could also obtain the same bands in the presence of oxygen in the discharge. However, in the picture (Fig. 1) obtained with this excitation, there appeared

two new groups on either side of the groups already reported by Singh. The picture was taken on a Hilger constant deviation spectrograph. The wavelengths of these discrete bands measured in these additional groups are as follows:

Red-side group				Violet-side group			
No.	Intensity	$\lambda$ in Å	$\nu_{vac.}$ in $cm^{-1}$	No.	Intensity	$\lambda$ in Å	$\nu_{vac.}$ in $cm^{-1}$
1	5	6205.0	16111	1	1	4899.3	20411
2	4	6226.0	16057	2	1	4923.4	20311

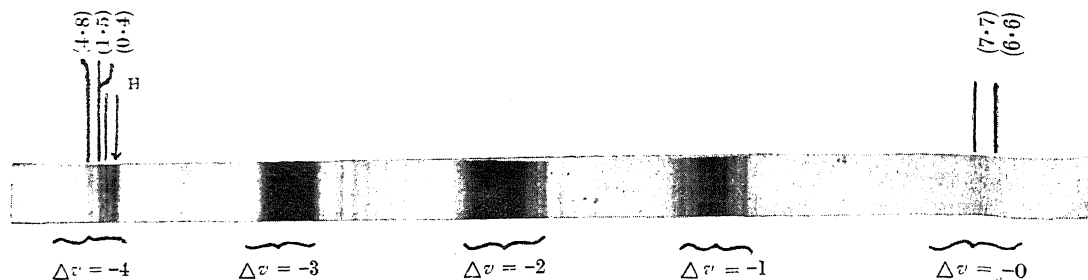


FIG. 1. The system with the new bands marked.

$v'$ \ $v''$	0	1	2	3	4	5	6	7	8
0			18530	17314	16111* (16109)				
1				18493	17294	16111* (16109)			
2					18442	17267			
3					19563	18391			
4						19484	17231 18324	17176	16057* (16057)
5							19384	18248	
6							20411* (20415)		
7								20311* (20282) Diffuse	

*N.B.*—Bracket figures give the calculated values of  $\nu$ .

As they gave the same structural appearance as Singh's bands, we tried to see whether we could fit them into the  $C^2\Sigma-B^2\Sigma$  system by using Singh's band head equation.

$$\nu = 21030 + (1113.3 v' - 14.3 v'^2) - (1268.8 v'' - 9.98 v''^2)$$

for the same. On comparison of the calculated and observed values of the band heads, the new discrete bands obtained on the plates fit into the sequences  $\Delta v = -4$  and  $\Delta v = 0$  not reported so far.

The Deslandre's table with the new and existing bands is drawn up below where the new bands observed are shown with an asterisk.

The new bands therefore are (0, 4), (1, 5) and (4, 8) of  $\Delta v = -4$  sequence and (6, 6) and (7, 7) of the  $\Delta v = 0$  sequence. It may be noted in the above table that although only one band head is actually measured at  $\lambda 6205.0$  ( $\nu = 16111 \text{ cm}^{-1}$ ), it represents two distinct bands (0, 4) and (1, 5) according to the band head equation. The (7, 7) band being diffuse, its wavelength measurement is uncertain by a relatively larger margin.

The absence of intermediate bands (2, 6) and (3, 7) in the  $\Delta v = -4$  sequence observed here, confirms the rather peculiar character of intensity distribution for the system, already remarked by Singh. Absence of intermediate bands in a sequence is not a very uncommon feature. Such a phenomenon is noticeable in a number of cases. For instance, in PN, the transition  $A^1\Pi-X^1\Sigma^+$  records the missing of two intermediate bands (2, 2) and (3, 3) in the particular sequence. In BO  $\beta$  system too, the band (2, 1) is missing in the sequence  $\Delta v = +1$  although the adjoining bands (1, 0) and (3, 2) are strong enough. Other similar cases can also be cited.

Our thanks are due to Dr. B. S. Patil, the Research Assistant, for help in the set-up of the exciting system.

Dept. of Physics,  
Karnatak University,  
Dharwar, May 1956.

N. R. TAWDE.  
M. R. KATTI.

1. Singh, N. L., *Curr. Sci.*, 1942, 11, 276; *Proc. Ind. Acad. Sci.*, 1949, 29, 424.

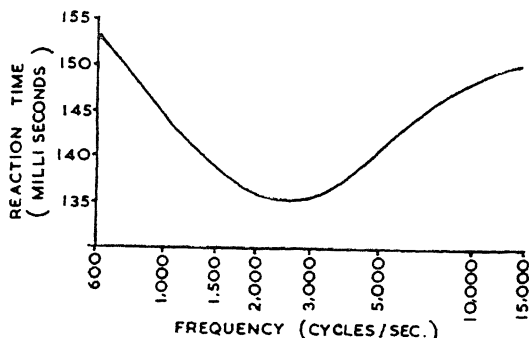
# AUDITORY REACTION TIME AS A FUNCTION OF FREQUENCY OF THE SIGNAL TONE

Two qualities are often considered essential in a sensory system for its optimum performance as a channel of information in a Display-Control situation. These are, firstly, the sensitivity of the system for slight changes in the stimuli and secondly, the quickness with which it responds to these changes. It has long been known that the human ear is maximally sensitive to tones of frequencies 2,000-4,000 c/s. But it was not clear whether the response of the auditory system to tones of this range of frequencies would be the quickest also. Previous workers on this question have reported apparently contradictory conclusions. Fessard and Kucharski<sup>1</sup> in an investigation of reaction times for different pitches and intensities found that shorter latencies in reaction were obtained for tones of higher frequencies than for lower ones. Chochalle<sup>2</sup> in another study of a similar nature found equal latencies for tones of all frequencies. In a study of the effects of high (above 2,000 c/s.) and low (below 2,000 c/s.) pitch noises on reaction time, Broadbent<sup>3</sup> found that the reaction time was lower for high pitched noises than for low pitched ones. These studies were presumably conducted under different experimental conditions and so the conclusions arrived at were naturally divergent.

In the present study, an attempt has been made to measure reaction times of subjects to tones of different frequencies (and not to tones of different pitches) ranging from 600 c/s. to 15,000 c/s. The output intensity of the signals (tones) was kept constant at 30 decibels. An audio-oscillator was used for generating the sound signals. Reaction time, that is, the time elapsing between hearing of the signal and pressing of a key by the subject, was measured with the help of an electronic timing device. The number of subjects taking part in this experiment was ten.

The average reaction times of the group of ten subjects for the various frequencies are shown in graphical form in the figure.

Analysis of variance of the data obtained showed that the differences between the mean reaction times for different frequencies are significant. It was also observed on further analysis that tones within the frequency range of 1,500-4,000 c/s. yielded the shortest reaction times. This result appears to be in conformity with expectations, since the human ear is also most sensitive to tones within this frequency



band. Fuller details regarding this work are being published elsewhere.

The authors are indebted to Dr. W. T. V. Adiseshiah for his keen interest in this work and to Mr. M. N. Bhattacharya for his help in statistical analysis.

Defence Science  
Laboratory,  
Pusa, New Delhi-12,  
May 8, 1956.

M. S. PRAKASH RAO.  
N. A. NAYAK.

1. Fessard, A. and Kucharski, P., *Ann. Psychol.*, 1955, 35, 103.
2. Chochalle, R., *Ibid.*, 1940, 41-42, 65.
3. Broadbent, D. E., *Med. Res. Council App. Psych. Unit Report*, 1954, 222/54.

## THE ABSORPTION SPECTRUM OF URANYL NITRATE IN AQUEOUS SOLUTIONS

THE molal extinction curve for aqueous solutions of uranyl nitrate is reported to consist of 11 regularly spaced bands in the region 4,860 Å-3,500 Å.<sup>1-3</sup> These give a mean value of 724 cm.<sup>-1</sup> for the frequency interval in the solution spectrum, which corresponds to 710 cm.<sup>-1</sup> frequency found in the absorption spectrum of crystalline uranyl compounds. Due to the constant  $\Delta\nu$ , resembling a vibration-like structure, the bands appear to form a single  $\nu'' = 0$  progression. From our spectrophotometric studies we find that whereas the curve in the region 4,860-3,500 Å. closely resembles that reported by Kasha,<sup>1</sup> there are five additional bands in the region 3,500-3,150 Å., which fact not only makes the total number of bands 16, but also points to another intensity maximum in the further ultraviolet. The absorption spectrum is reproduced in Fig. 1.

It is unlikely that the entire group of 16 bands form a single progression, when in the fluorescence spectrum the  $\nu'' = 0$  progression is much shorter, consisting of about 6 bands. Besides this, the intensity maximum in fluores-

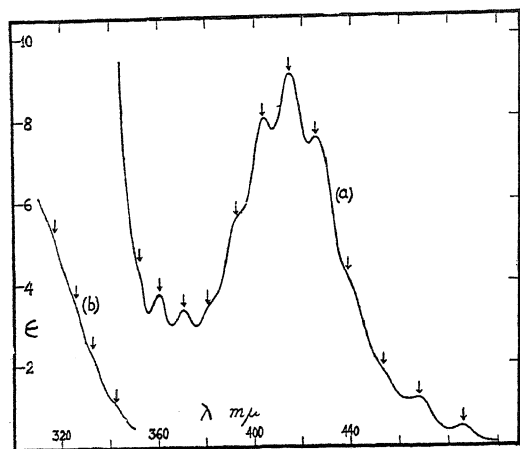


FIG. 1. Spectrophotometric curve for Uranyl Nitrate in aqueous solutions. (a) for 0.040N solution, (b) for 0.0025 N solution, scale reduced to 1/16.

cence falls in the second band, while in the present case the intensity maximum is at the sixth band (4,140 Å). Also if the entire curve is taken to be a single progression, the occurrence of another intensity maximum in the ultraviolet remains to be explained.

In the solid state, particularly at low temperatures, where reliable data are available, it has not been found possible to explain the absorption bands beyond the fifth as a single  $v''=0$  progression,<sup>4</sup> and the higher frequency bands necessitate the assumption of other electronic transitions.<sup>5</sup> It is interesting to find that Dieke and Duncan have suggested at least three electronic series of bands for the  $\text{UO}_2^{++}$  ion in uranyl nitrate, starting at 4,860, 4,654 and 3,672 Å, and designated as fluorescence, magnetic and ultraviolet series respectively. A study of the curve in Fig. 1 clearly points to the starting of a new electronic transition from 3,700 Å, so that the bands in the ultraviolet form a separate series. The fluorescence series obviously starts at 4,860 Å, but the whole group of 9 bands up to 3,805 Å does not seem to form a single series. For, an examination of the curve in Fig. 1 will indicate that as we proceed on the longer wavelength side starting from the sixth band at 4,140 Å the resolution of bands between 4,350 and 4,600 Å is disturbed. This points to the overlapping of two different series in this region: the fluorescence series and another one which starts at about 4,600 Å. Thus there is broad agreement between the absorption spectra of solids and solutions in the case of uranyl nitrate. Sutton's observation<sup>3</sup> that, on changing the pH of the solutions by adding different amounts of NaOH, the absorption in

the middle region of the curve and that in the other two regions vary differently, is in conformity with the view that at least 3 different electronic transitions are involved in the absorption spectrum of uranyl nitrate.

The approximate constancy of  $\Delta\nu$  in the bands appears to be due to observational difficulties, overlapping of bands, and asymmetrical broadening owing to causes such as perturbations, etc. In fact the constancy is only very approximate, and individual  $\Delta\nu$  values varying from 620  $\text{cm}^{-1}$  to 780  $\text{cm}^{-1}$  are observed. In other solutions, e.g., uranyl acetate,<sup>6</sup> the deviations are much larger.

Dept. of Physics,  
DSB Govt. College,  
Nainital, May 16, 1956.

D. D. PANT.

D. P. KHANDELWAL.

1. Kasha, M., *J. Chem. Phys.*, 1949, **17**, 349.
2. Betts, R. H. and Harvey, B. G., *Ibid.*, 1948, **16**, 1089.
3. Sutton, J., *J. Chem. Soc. Suppl.*, 1949, No. 2, S 275.
4. Pant, D. D., *Proc. Ind. Acad. Sci.*, 1950, **31A**, 35.
5. Dieke, G. H. and Duncan, A. B. F., *Spectroscopic Properties of Uranium Compounds*, 1949, (McGraw-Hill).
6. Pant, D. D. and Khandelwal, D. P., *Curr. Sci.*, 1955, **24**, 376.

### NEW EMISSION SPECTRUM OF BROMINE IN THE FAR AND VACUUM ULTRAVIOLET

THE emission spectrum of bromine as excited both in condensed discharge from a 20 K.V. transformer and in high frequency discharge from a 100 watt oscillator is photographed in the quartz ultraviolet region using a Medium Quartz spectrograph and in the vacuum ultraviolet region using a one metre normal incidence vacuum grating spectrograph.

Photographs of the spectra reveal five new systems lying between  $\lambda 2100$ – $\lambda 1580$ . Of these, two systems lying in the regions  $\lambda 2100$ – $\lambda 1850$  and  $\lambda 1850$ – $\lambda 1700$  are extensive, each consisting of about 70 bands. The remaining three brief systems occur below  $\lambda 1700$  and are similar in appearance to the brief systems of iodine observed below  $\lambda 1790$ . In addition to these discrete band systems, a series of semi-continuous diffuse bands in the region lying between  $\lambda 4200$ – $\lambda 2200$ , most of which were previously reported and interpreted by Venkateswarulu<sup>1</sup> are also recorded.

Vibrational analyses of the five new systems have led to the determination of the constants given in Table I. All these systems are found to be analogous to those reported and analysed

by us, earlier in the case of iodine (Haranath and Rao<sup>2</sup>). According to the vibrational analysis, all these systems have for their final level, the ground state of the neutral bromine molecule, the upper states arising from different stable excited electronic levels. Table I gives the positions of all the stable electronic levels derived from the analysis of the discrete band systems so far observed either in emission or in absorption in bromine. Starting from the ground state X these levels are designated as A, B, etc. Under remarks column, the transitions involved in various systems are also indicated.

TABLE I

*Stable electronic levels so far observed in the spectrum of neutral bromine molecule*

Position of the level	Designation	Frequency	Remarks
62266*	I.	293	L-X gives a brief system of about 10 red degraded emission bands in the region $\lambda$ 1630- $\lambda$ 1580
61444	O	220	Some groups of semi-continuous diffuse emission bands arise in this level and have for their final levels different lower repulsive states
60879*	M	426	M-X gives a brief system of 20 violet degraded emission bands in the region $\lambda$ 1690- $\lambda$ 1610
59855*	L	281	L-X gives a brief system of 15 red degraded bands in the region $\lambda$ 1690- $\lambda$ 1650
56303*	J	256	J-X gives an extensive and clearly red degraded band system in the region $\lambda$ 1850- $\lambda$ 1700
55534	I	330	Some groups of diffuse bands arise in this level which have their final levels as repulsive states
51800*	II	120	H-X gives an extensive line like band system in the region $\lambda$ 1850- $\lambda$ 2100
15891	B	169.7	X-B gives absorption bands in the region $\lambda$ 8672 - $\lambda$ 5110 <sup>3</sup>
13814	A	170.7	X-A gives absorption bands in the region $\lambda$ 8180- $\lambda$ 6450 <sup>3</sup>
0	X	323.2	Ground state

\* Newly identified in the present work.

The nature and properties of various electronic states in terms of electronic configurations will be discussed in detail and published elsewhere.

Dept. of Physics,  
Andhra University,  
Waltair, May 23, 1956.

P. B. V. HARANATH.  
P. TIRUVENGANNA RAO.

1. Venkateswarulu, P., *Proc. Ind. Acad. Sci.*, 1947, **25 A**, 138.
2. Haranath, P. B. V. and Tiruvenganna Rao, P., *Curr. Sci.* 1956, **25**, 151.
3. Darbyshire, *Proc. Roy. Soc.*, 1937, **159 A**, 93.

### OPTICAL BEHAVIOUR OF IRIDESCENT SODIUM NITRATE CRYSTALS

CRYSTALS of sodium nitrate often exhibit iridescence when twinning layers are present in them parallel to one edge of the rhombohedral cleavage and equally inclined to the other two. The existence of such layers, besides being responsible for iridescence, leads to many interesting optical phenomena. The following descriptions summarise their significant features:

(1) When a distant point source of white light is seen through the opposing faces of the rhombohedral cleavage and the twinning layer, three images are seen instead of one. The central image is colourless and unpolarised and remains stationary irrespective of the tilt of the crystal. The two outer ones show vivid colours; their colour as well as their position change with the tilt of the crystal; and lastly, their polarisation is very characteristic—the two are polarised orthogonally and their planes of polarisation suffer a rotation through a right angle during the passage of light through the twinning layer. If a narrow illuminated slit is viewed instead of a point source, the two outer images are seen to be drawn out into spectra. Under favourable conditions some specimens show interference fringes in the spectra parallel to the length of the slit.

(2) The crystallographic orientation of the twinning layer influences all optical phenomena profoundly. The following observation illustrates it. A distant source of light is viewed through those faces none of whose edges is parallel to the twinning layer. The twinning layer is held vertical; the plane of observation, which is horizontal, then coincides with the plane of symmetry common to both the twinning layer and the crystal in which it is embedded. With this setting only the central image is visible. A departure from the plane of symmetry, however small, immediately revives the outer images. The greater is such a departure, the brighter are those images. These intensity variations may be seen simultaneously if a linear source of light is employed.

(3) A diffusing screen, illuminated preferably by monochromatic light, is viewed through the crystal held in the manner as indicated

in (2). On turning the crystal about the vertical axis, one sees the optical field divided into two halves differing in their intensity of illumination. A dark and sharply defined boundary is seen to separate the two halves of the field except where it is cut by the plane of symmetry. If the illuminated screen is held to one side so that light reflected from or refracted by the twinning layer comes into view, a bright arc of light separating a bright from a dark field is seen. The arc is divided into two halves by the plane of symmetry. Interference fringes running parallel to these boundaries are seen with some of the specimens.

Phenomena of the same nature as described above are exhibited by iridescent calcite. Their origin has been elucidated in two recent papers by Raman and Ramdas<sup>1</sup> and by Ramdas.<sup>2</sup> Identical explanations hold good for the optical effects observed with sodium nitrate and reference may be made to the papers quoted above. Interference phenomena, so strikingly seen with iridescent calcite in phenomena of the type described in (1) and (3), are however not readily observed with all the sodium nitrate specimens studied. An optimum thickness of the twinning layer depending upon the birefringence of the substance is necessary to bring out these effects. The outer images are, as noted above, drawn out into spectra. These images owe their existence to the transformation by the twinning layer of ordinary waves into extraordinary and *vice versa*. The spectral character of the deviated images is thus dependent on the relative dispersion of the ordinary and the extraordinary refractive indices. This is more marked for sodium nitrate than for calcite and hence results in a greater dispersion of the deviated images seen with the former. The larger birefringence of sodium nitrate compared to that of calcite also increases the curvature of the boundaries seen with the former in the optical fields of transmission, reflection and transmission.

C/o. Meteorological Office, A. K. RAMDAS.  
Poona-5, June 25, 1956.

1. Raman, Sir C. V. and Ramdas, A. K., *Proc. Ind. Acad. Sci.*, 1954, **40 A**, 1.
2. Ramdas, A. K., *Ibid.*, 1954, **40 A**, 217.

#### FERRIC AMMONIUM PARAMOLYBDATE

AMMONIUM FERRICO DODECAMOLYBDATE was prepared earlier<sup>1-4</sup> by several workers and was formulated according to Rosenheim as  $(\text{NH}_4)_3\text{H}_6[\text{Fe}(\text{MoO}_4)_6]$ . Details of prepara-

tion were not clearly defined. It reveals<sup>5</sup> that Rosenheim's formula for 6-poly acids is not correct. He thought worthwhile to prepare the compound and establish its composition. A quantity of ferric ammonium alum (7.8 g./100 ml.) was added to an aqueous solution of A.R. Ammonium phosphate (11.2 g./100 ml.). The yellowish precipitate obtained (pH of the filtrate was 4.5) was purified and dried at 140-150°C. The weight of the dried sample was 0.5 g. The ammonia and iron contents by standard methods. [Found:  $\text{NH}_3 = 4.16$  and  $\text{Fe} = 4.37$  and  $\text{Fe} = 4.8\%$ .] The compound  $\text{Fe}(\text{NH}_4)_3\text{Mo}_7\text{O}_{24}$  is also recently indicated by several isopolymolybdates under different conditions was established by several Cryoscopic,<sup>8</sup> spectrophotometric<sup>10</sup> and structure<sup>5,11,12</sup> determinations of the compound. The presence of  $\text{MoO}_4^{2-}$  in the presence of an identical  $\text{U}_7\text{O}_{24}^{6-}$  is also recently indicated. There arises only two possibilities for the position of the compound obtained: (1)  $\text{Fe}_2\text{Mo}_7\text{O}_{24}$ , (2)  $\text{Fe}(\text{NH}_4)_3\text{Mo}_7\text{O}_{24}$  without water of crystallisation and the results answered to the latter conclusion. It is worthwhile to mention that the compound dissolves readily in excess of 10% solution. The solutions thus obtained were found not to give tests for free molybdate and ferric ions respectively. This will be reported in greater detail later on.

Thanks are due to the B.S.I.R., Government of India, for a grant, and to Dr. S. Pani for help. Dept. of Chemistry, D. V. RAO  
Ravenshaw College,  
Cuttack, March 20, 1956.

1. Marckwald, E., *Dissertation*, Berlin, 1914.
2. Hall, R. D., *J. Amer. Chem. Soc.*, 1914, **36**, 1914.
3. Ray, P. et al., *J. Ind. Chem. Soc.*, 1914, **39**, 224.
4. Rosenheim, A. and Schwer, H., *Z. Anorg. Chem.*, 1914, **89**, 224.
5. Anderson, J. S., *Nature*, 1937, **140**, 1937.
6. Jander, G., et al., *Z. Anorg. Chem.*, 1933, **215**, 310.
7. Britzinger, H. and Ch. Ratanarat, *Ibid.*, 1937, **215**, 310.
8. Bye, J., *Ann. Chim.*, 1945, **20**, 463.
9. Carpeni, G., *Bull. Soc. Chim.*, 1947, **1947**, 1947.
10. Lindqvist, I., *Act. Chem. Scand.*, 1947, **1**, 1947.
11. Evans, J. H., *J. Amer. Chem. Soc.*, 1947, **69**, 1947.
12. Lindqvist, I., *Arkiv. Kemi.*, 1950, **2**, 1950.
13. *Ann. Rep. Chem. Soc.*, 1952, 103.

# A RAPID PROCEDURE FOR THE ESTIMATION OF AVAILABLE NITROGEN IN SOILS

Of the methods<sup>1</sup> which have been used for assessing the nitrogen-supplying power of soils, those involving the estimation of mineralisable nitrogen after incubation at optimum moisture and temperature have received the greatest attention.<sup>2,3</sup> In the recent rapid nitrification techniques<sup>4-6</sup> there has been considerable saving of time but still these procedures are time-consuming and are not very suitable for rapid soil testing work. Alkaline permanganate as a reagent for characterising the nature of nitrogen has been in use for organic manures<sup>7</sup> and its application to estimate the easily decomposable soil organic nitrogenous fraction has been little attempted.<sup>8</sup>

Studies using different strengths of alkaline permanganate from 5%  $\text{KMnO}_4$  + 40% NaOH to 0.25%  $\text{KMnO}_4$  + 2% NaOH in about six different soils of the country indicated that the amounts of nitrogen released by 5%  $\text{KMnO}_4$  + 40% NaOH strength was 40 to 90% of the total nitrogen while the amounts released by 0.5%  $\text{KMnO}_4$  + 4% NaOH and lower strengths of alkaline permanganate were approximately comparable with the mineralisable nitrogen of soils after 45 days' incubation.

The amounts of soil nitrogen released by (i) 0.5%  $\text{KMnO}_4$  + 4% NaOH, (ii) 0.32%  $\text{KMnO}_4$  + 2.5% NaOH, and (iii) 0.25%  $\text{KMnO}_4$  + 2% NaOH in 29 soils from different parts of India are given in the table together with the mineralisable nitrogen, total organic nitrogen and pH of the soils.

As seen from Table I, the nitrogen extracted by (i) 0.5%  $\text{KMnO}_4$  + 4% alkali, and (ii) 0.32%  $\text{KMnO}_4$  + 2.5% alkali correlated best with the mineralisable nitrogen (the correlation coefficients being significant at 1% level) while those obtained with (i) total nitrogen, and (ii) 0.25%  $\text{KMnO}_4$  + 2% NaOH were comparatively low. As the values of nitrogen extracted by 0.32%  $\text{KMnO}_4$  + 2.5% NaOH were of the same order as the mineralisable nitrogen, this strength appears to be most suitable for the estimation of available nitrogen.

On the basis of the above work, the following simple chemical method is recommended for the estimation of available nitrogen in soils: 20 g. of soil are taken in a one litre distillation flask and 20 c.c. of water are added. 100 c.c. of 0.32%  $\text{KMnO}_4$  and 100 c.c. of 2.5% NaOH both freshly prepared are added and the material digested. 30 c.c. of the distillate are

collected in a standard N/50 acid and excess titrated against alkali using methyl red indicator. In the case of soils having high organic matter, addition of a little paraffin prevents frothing and facilitates distillation.

TABLE I

Relationship between mineralisable nitrogen and (a) nitrogen extracted by (i) 0.5%  $\text{KMnO}_4$  + 4% NaOH, (ii) 0.32%  $\text{KMnO}_4$  + 2.5% NaOH, (iii) 0.25%  $\text{KMnO}_4$  + 2% NaOH, and (b) Total organic nitrogen\*

S. No.	Place	Mineralisable N in mg. per 100 g. of soil	Nitrogen in mg./100 g. of soil extracted by			Total N in mg. per 100 g. of soil	pH
			(i)	(ii)	(iii)		
1	Akola (a)	15.6	16.8	13.9	13.3	45.5	8.2
2	Akola (b)	12.1	19.6	14.0	11.2	39.2	7.9
3	Ludhiana (a)	12.3	15.1	11.3	9.95	35.7	..
4	Ludhiana (b)	10.8	11.2	10.9	9.8	57.4	8.1
5	Poona (a)	10.0	15.4	14.0	11.9	88.2	8.0
6	Poona (b)	12.5	15.8	12.3	11.9	58.8	8.0
7	Tharsa	11.4	12.6	9.1	9.1	58.0	7.9
8	Kaduveli	9.4	17.5	12.6	11.9	65.1	7.9
9	Palligaon	12.7	12.6	9.0	9.1	32.9	8.0
10	Travalem	14.7	23.1	15.2	11.9	79.0	5.9
11	Avichavadi	11.2	16.7	12.6	11.2	54.0	7.4
12	Nachinthaotham	14.4	15.0	11.9	9.5	53.9	6.7
13	Kota	7.9	10.5	9.8	6.3	53.9	7.9
14	Coimbatore	12.3	9.7	8.7	6.3	48.3	8.7
15	Udayagiri (a)	12.0	16.2	14.0	8.4	65.8	5.2
16	Udayagiri (b)	14.8	27.4	15.4	12.8	74.2	6.2
17	Udayagiri (c)	11.7	17.2	15.4	9.4	95.9	6.6
18	Pusa	12.0	12.6	11.0	6.5	33.6	3.2
19	Nagra village	5.7	8.4	7.8	7.7	44.8	7.7
20	Tungabhadra	6.1	6.8	5.9	5.9	25.2	8.2
21	Ratnagiri	12.2	23.2	18.2	14.8	65.8	6.3
22	Madhya Saurashtra (a)	11.2	20.7	16.8	12.9	107.1	8.1
23	Madhya Saurashtra (b)	6.3	7.3	7.3	6.6	36.4	8.5
24	Surat	9.4	12.5	8.6	8.6	72.8	7.0
25	Bhavnagar	5.6	11.2	9.8	7.1	36.4	8.8
26	Limbdi	5.4	9.4	7.6	..	33.8	8.3
27	Hiebbal (Mysore)	15.9	16.9	15.4	9.5	72.8	7.4
28	Visvesvaraya Canal Farm	7.0	9.5	8.4	7.6	48.3	6.3
29	Gauhati	13.1	20.0	13.7	10.2	81.2	5.4

\* Includes ammoniacal, nitrate and soluble organic nitrogen fractions. The coefficient of correlation between columns 3 and 4: 0.70; between columns 3 and 5: 0.69; between columns 3 and 6: 0.56; between columns 3 and 7: 0.42.

The values obtained by this method were found to have significant correlation with paddy and wheat crop responses in a number of soils. The details are being published elsewhere.



The authors' thanks are due to Dr. S. P. Raychaudhuri and Dr. R. V. Tamhane for their interest and encouragement in the course of the work.

Division of Soil Science and B. V. SUBBIAH.  
Agric. Chemistry, G. L. ASIJA.  
Indian Agric. Res. Inst.,  
New Delhi, February 2, 1956.

1. Desai, S. V. and Subbiah, B. V., *Ind. J. Agric. Sci.*, 1952, **22**, Part II, 167.
2. Gainy *et al.*, *J. Agric. Res.*, 1917, **11**, 43.
3. Richardson, *Proc. Int. Soc. Soil Sci.*, Dublin, 1952, **2**, 28.
4. Fitts, J. W. *et al.*, *Proc. Soi Soc. Amer. Proc.*, 1955, **19**, 69.
5. Stanford, G. and Hanway, *Ibid.*, 1955, **19**, 74.
6. Munson, R. D. and Stanford, G., *Ibid.*, 1955, **19**, 464.
7. *Official Methods of Analysis of the Association of Official Agric. Chemists*, 1950, 7th Edition.
8. Truog, E., 1955, Quoted by Munson and Stanford, cited above.

#### ABSENCE OF TRUE VITAMIN B<sub>12</sub> ACTIVITY OF PULSES

ROHATGI *et al.*<sup>1</sup> have reported values for the vitamin B<sub>12</sub> activity in some pulses as determined by the microbiological method employing *Lactobacillus leichmannii* as the test organism. Shive *et al.*<sup>2</sup> and Kitay *et al.*<sup>3</sup> have shown that in addition to cyanocobalamin, certain purines and desoxyribosides could effectively replace vitamin B<sub>12</sub> for *L. leichmannii* in a suitable medium. Hoffmann *et al.*<sup>4</sup> demonstrated that vitamin B<sub>12</sub> could be distinguished from other substances in liver extract by the almost complete destruction of the vitamin in the extract maintained at 100°C. for 30 minutes in 0.2N sodium hydroxide solution. Peeler *et al.*<sup>5</sup> by applying the above method to plant materials, found that nearly 90% of the vitamin B<sub>12</sub> activity was due to substances other than cyanocobalamin, possibly due to desoxyribosides. Bickoff *et al.*<sup>6</sup> were led to the same conclusion in identifying the vitamin B<sub>12</sub> like growth factors in alfa alfa.

In the course of an investigation on the faecal excretion of vitamin B<sub>12</sub> like compounds in rats maintained on vegetable protein diets, it was considered necessary to determine the amount of the vitamin B<sub>12</sub> present in the diets, which contained besides cereals, the common pulses, viz., Bengal gram, black gram, green gram and red gram. Since Rohatgi *et al.*<sup>1</sup> did not subject the pulse extracts to alkali treatment their results leave room for doubt as to the true nature of the microbially active substances reported by them. A similar objection was recently raised in an article in the *Nutrition*

Reviews.<sup>7</sup> Hence, extracts prepared from the four pulses according to the procedure of Rohatgi *et al.*<sup>1</sup> were subjected to alkali treatment and vitamin B<sub>12</sub> activity assayed by the method of Skeggs *et al.*<sup>8</sup> employing *L. leichmannii* (A.T.C.C., 4797) as the assay organism. The average values obtained on three independent estimations of each pulse are given in Table I. These results would go to show that the factors stimulating the growth of the organism would in all probability be substances other than cyanocobalamin. This was also confirmed by adding known quantities of vitamin B<sub>12</sub> to the pulse extracts and subjecting them to alkali treatment, when the destruction of the added vitamin was found to range from 90% to 99%.

TABLE I  
Vitamin B<sub>12</sub> activity of pulses

Sample	B <sub>12</sub> activity µg./100 g.	
	Control	After alkali treatment
Bengal gram ( <i>Cicer arietinum</i> )	.. 0.278	0.259
Black gram ( <i>Phaseolus mungo</i> )	.. 0.295	0.294
Green gram ( <i>Phaseolus radiatus</i> )	.. 0.807	0.818
Red gram ( <i>Cajanus indicus</i> )	.. 0.404	0.427

Nutrition Res. Labs., M. RAMACHANDRAN.  
Indian Council of S. V. PHANSALKAR.  
Medical Res.,  
Coonoor, S. India,  
May 21, 1956.

1. Rohatgi, K., Banerjee, M. and Banerjee, S., *J. Nutr.*, 1955, **56**, 403.
2. Shive, W., Ravel, J. M. and Harding, W. M., *J. Biol. Chem.*, 1948, **176**, 991.
3. Kitay, E., McNutt, W. S. and Snell, E. E., *J. Bact.*, 1950, **59**, 727.
4. Hoffmann, C. E., Stokstad, E. L. R., Hutchings, B. L., Dornbush, A. C. and Jukes, T. H., *J. Biol. Chem.*, 1949, **181**, 635.
5. Peeler, H. T., Yacowitz, H., Carlson, C. W., Miller, R. F., Norris, L. C. and Heuser, G. F., *J. Nutr.*, 1951, **43**, 49.
6. Bickoff, E. M., Livingston, A. L. and Snell, N. S., *Archiv. Biochem.*, 1950, **28**, 242.
7. *Nutrition Reviews*, 1956, **14**, 79.
8. Skeggs, H. R., Nepple, H. M., Valentik, K. A., Huff, J. W. and Wright, L. D., *J. Biol. Chem.*, 1950, **184**, 211.

#### RAMAN SPECTRUM OF m- FLUOROBROMOBENZENE

THE Raman spectrum of meta-fluorobromobenzene was obtained in the liquid state. There is no previous report on the Raman spectrum of this compound excepting for the interpolated frequencies given by Kohlrausch.<sup>1</sup>

TABLE I

$\Delta\nu$	Int.	App.	$\rho$	$\Delta\nu$	Int.	App.	$\rho$	$\Delta\nu$	Int.	App.	$\rho$
*175	55	d	.87	774	10	vd	.26	1156	23	d	.87
*206	26	sh	.87	799	5	d	..	1215	40	vd	.01
*244	58	d	.87	859	18	d	.25	1264	15	sh	.19
*308	71	sh-d	.32	944	9	sh	..	1294	11	vd	..
436	5	d	.45	*1002	100	sh	.05	1475	8	sh	.02
*521	28	sl-d	.46	1056	42	sh	.02	1591	44	sh d	.87
*555	9	d	.67	1082	15	sh-d	.30	3079	64	vb	.27
*666	50	vsh	.11	1111	19	vd	.01	3176	7	bd	.16

The experimental details are the same as described in an earlier communication by the author.<sup>2</sup> About 24 Raman lines were recorded and the shifts, intensities, appearance and depolarisation factors of the lines are given in Table I. Lines marked with asterisks were obtained as Stokes' as well as anti-Stokes' lines. The abbreviations used to denote the appearance of the lines are:

sh = sharp; vsh = very sharp; d = diffuse; vd = very diffuse; b = broad; and vb = very broad.

The author is grateful to Dr. G. C. Finger for the gift of the sample and to the Government of India for the award of a senior research scholarship, and to Prof. K. R. Rao for his valuable guidance.

Dept. of Physics, S. L. N. G. KRISHNAMACHARI.  
Andhra University,  
Waltair, May 21, 1956.

1. Kohlrusch, K. W. F., *Mh. Fur. Chem.*, 1947, **76**, 249.
2. Krishnamachari, S. L. N. G., *Curr. Sci.*, 1956, **25**, 185.

### STEROIDS IN HUMAN SMEGMA

CLINICAL and statistical evidence which has accumulated during the last 30 years suggests that cancer of the penis<sup>1-3</sup> is much more frequent in uncircumcised men or in those in whom circumcision was performed during the later years of childhood. It has further been suggested that cancer of the cervix-uteri<sup>3-5</sup> is also probably more frequently encountered in women of communities, in whom circumcision in the male is not usually practised. It is believed, that the thick cheesy secretion (smegma) which accumulates under the prepuce and is not washed off during the prevalent process of washing and bathing may be associated with the development of these cancers. A plea has therefore been made that compulsory circum-

cision<sup>6</sup> should be performed in early infancy as a prophylactic measure. It must, however, be admitted that experimental proof<sup>7,8</sup> of the carcinogenic potentiality of dried smegma is still lacking. It may also be mentioned that our knowledge of the chemical composition<sup>9,10</sup> of human smegma is still very incomplete.

It is on account of these considerations that biological and chemical studies on smegma have been initiated at these laboratories. Working with human smegma, it is found that the petroleum ether extract contains three hitherto unisolated crystalline compounds, A, B and C as its major constituents.

Compound A is sparingly soluble in alcohol and acetone, and crystallizes from acetone in colourless granules, m.p. 80-81° C. (Found = C, 82.4; H, 12.5.  $C_{47}H_{86}O_2$  requires C, 82.6; H, 12.7%).

Hydrolysis of the compound A, with 1% sodium ethoxide solution yielded a neutral product and an acid. The neutral product crystallized from methyl alcohol, in shining plates, m.p., 140.5° C. (Found: C, 83.0; H, 12.6.  $C_{27}H_{48}O$  requires C, 83.4; H, 12.5%.) A mixed melting point of this product with the compound C remains undepressed. The acid obtained in hydrolysis of compound A, on repeated crystallizations from ethyl alcohol melted at 57.5° C. (Found: C, 76.9; H, 12.9.  $C_{20}H_{40}O_2$  requires C, 76.86; H, 12.9%. Neutralization equivalent found: 316.8.  $C_{20}H_{40}O_2$  requires 312.)

Compound C crystallises from methyl alcohol in lustrous plates, m.p. 140.5° C. (Found: C, 83.8; H, 12.3.  $C_{27}H_{48}O$  requires C, 83.4; H, 12.5%.) It formed a monoacetate,<sup>11</sup> m.p. 110° C. and a monobenzoate,<sup>11</sup> m.p. 136° C. These properties of compound C and its infrared spectrum<sup>12</sup> indicated it to be  $\beta$ -cholestanol. A mixed melting of compound C, with an authentic sample of  $\beta$ -cholestanol<sup>13</sup> synthesised from cholesterol, remained undepressed and confirmed their identity. Incidentally, the neutral product from compound A proved to be

$\beta$ -cholestanol and compound A, an ester of  $\beta$ -cholestanol.

Compound B crystallizes from a mixture of acetone and water in colourless slender rods, m.p. 117° C. (Found: C, 81.7; H, 12.0.  $C_{10}H_{34}O$  requires C, 81.95; H, 12.31%.) The compound exhibits yellowish-green fluorescence on alumina column. It is a steroid and occurs in very poor yield.

Details about the isolation and studies on compound B and the acidic moiety in compound A which are in progress, will be communicated later.

We are indebted to the Indian Council of Medical Research under whose auspices the present work has been carried out, and to Dr. R. V. Rajam for a generous collection of smegma required in the investigation.

Dept. of Biochemistry, V. B. KAMAT.  
Indian Cancer Res. Centre, T. B. PANSE.  
Parel, Bombay-12, V. R. KHANOLKAR.  
India, May 20, 1956.

1. Wolbarst, A. L., *Lancet*, 1932, **1**, 150.
2. Sorsby, M., *Cancer and Race*, Bale, London, 1931, pp. 120.
3. Khanolkar, V. R., *Acta DeL'union Internat. Centre Le Cancer*, 1950, **6**, 881.
4. Horwitz, A., *Surg. Gynec. and Obst.*, 1927, **44**, 355.
5. Wynder, E. L., *British Medical J.*, 1955, 743.
6. Bleich, A. R., *J.A.M.A.*, 1950, **143**, 1054.
7. Fishman, M., Shear, M. J., Friedman, H. and Stewart, H., *J. Nat. Cancer Inst.*, 1942, **2**, 361.
8. Plaut, A. and Kohn-Speyer, A. C., *Science*, 1947, **105**, 391.
9. Sobel, H., *J. Invest. Dermat.*, 1949, **13**, 336.
10. Hatsuo Nitta and Kimio Ikai, *Nagoya Med. J.*, 1953, **1**, 217.
11. Heath-Brown, B., Heilbron, I. M. and Jones, E. R. H., *J. Chem Soc.*, 1940, 1483.
12. Dobriner, K., Katzenellenbogen, E. R., and Norman Jones, R., *Infra-red Spectra of Steroids*, Interscience Publishers, New York, 1953.
13. Diels, O. and Abderhalden, H., *Ber.*, 1906, **39**, 884.

## SYNTHESIS OF AN ANALOGUE OF PAPAVARINE

A NUMBER of analogues of alkaloids have been synthesised and compounds related to papavarine have received much attention due to expectancy of physiological activity.<sup>1</sup> The synthesis of related compounds carrying an alkyl group in the heterocyclic ring has not received much attention, and so a programme of work was undertaken on the suggestion, and under the guidance of Dr. K. N. Menon. The synthesis of 1-(2', 5'-dimethoxy benzyl)-3 methyl-3 : 4-dihydro-6, 7-methylenedioxy-isoquinoline is now reported.

N-(2, 5-DIMETHOXY PHENYL ACETYL)- $\alpha$ -METHYL-HOMOPIPERONYLAMINE

$\alpha$ -Methyl homopiperonylamine (3 g.) and 2, 5-dimethoxy phenyl acetic acid chloride (2 g.) were refluxed in dry chloroform for 3 hours. The reaction mixture was cooled, poured into ice-water, the chloroform layer washed successively with dilute hydrochloric acid, sodium bicarbonate and water. The extract after drying over anhydrous sodium sulphate, was freed of chloroform. The residue was extracted with hot benzene yielding the solid amide (2 g.), m.p. 129° C. (from dilute ethanol). (Found: N, 3.96. Calculated: N, 3.92.)

1-2', 5'-DIMETHOXY BENZYL)-3 METHYL, 3 : 4-DIHYDRO-6, 7-METHYLENEDIOXYISOQUINOLINE

The above amide (0.5 g.) in 30 c.c. of benzene was treated with 3 c.c. of phosphorous oxychloride and the mixture refluxed on a water-bath for 3 hours. The cooled reaction mixture was poured into water, aqueous layer separated and made ammoniacal to yield the base which separated as a paste, and could not be crystallised. Its picrate (0.4 g.) crystallised from methanol in golden yellow plates, m.p. 243° C.

Found: N, 9.72.  $C_{20}H_{21}O_4N.C_6H_5O_7N_3$  requires 9.86%.

Dept. of Organic Chemistry, T. K. GOVINDAN.  
University of Madras,  
Madras-25, June 30, 1956.

1. Dobrowski, A., *Monatsh*, 1951, **82**, 122.

## THE RELATION OF ASCORBIC ACID TO FUSARIUM WILT IN LINSEED

THE relation of yellows and mosaic resistance to high ascorbic acid content in cabbage has been reported by Walker.<sup>1</sup> Similarly Kalyanasundaram<sup>2,3</sup> observed reduction in ascorbic acid content in leaves and increase in reducing sugars during fusarium wilt in cotton and redgram. Resistance to diseases in plants has been thus attributed to their high ascorbic acid content and this conclusion has been tested here in the case of fusarium wilt of linseed.

Highly wilt susceptible linseed variety I.P.I.6 was used throughout these experiments. Ascorbic acid content was determined by indophenol visual titration method.<sup>4</sup>

Analysis of the three different leaf samples of the infected linseed plants (Table I) indicated that the quantity of ascorbic acid progressively decreased with advancing wilt symptoms, thus confirming the previous findings.<sup>2,3</sup>

TABLE I

Mg. ascorbic acid per 100 g. fresh weight of leaves

Sample No.	Control (uninfected)	Initial wilt	Advanced wilt	Wilted
1	159.90	104.55	57.81	36.90
2	178.50	71.40	47.60	35.70
3	175.50	46.80	35.10	23.40

A study was then made of the effect of increasing ascorbic acid in the linseed plants on resistance to fusarium wilt. For this purpose plants grown in Shive and Robbins<sup>5</sup> water culture solution were transferred to a number of tubes each containing 50 mg. of ascorbic acid in 250 ml. distilled-water, and allowed to absorb the chemical for 6 hours. The quantity of ascorbic acid absorbed per plant was also determined from the quantity of the substance left in the tubes. Ascorbic acid absorbed varied from 15 mg. to 38 mg. per plant. Thereafter the plants were transferred back to their original containers. Along with control series they were then infected with equal quantities of uniform suspension of mycelial mat of fusarium linum.

Contrary to expectation the wilt symptoms appeared earlier in plants treated with ascorbic acid. All the treated plants wilted completely after 7 days while control plants did not show any wilt symptoms at that stage. Leaves of the treated and of the unwilted control plants were then analysed for their ascorbic acid content. It was found that even after complete wilt, treated plants contained more ascorbic acid than the unwilted control plants. Similar results were obtained when stem and roots were analysed.

It appears that ascorbic acid when supplied artificially does not induce resistance to wilt in linseed. On the contrary, it hastened the development of wilt symptoms.

Grateful thanks are due to Prof. R. H. Dastur for suggestions and kind interest.

JAYENDRA G. BHATT.

Institute of Plant Industry,  
Indore, July 9, 1956.

1. Walker, J. C., *Phytopathology*, 1944, **34**, 1012.2. Kalyanasundaram, R., *Proc. Ind. Acad. Sci.*, 1952, **36 B**, 102.3. —, *Ibid.*, 1955, **42 B**, 145-53.4. Bessey, O. A. and King, C. G., *J. Biol. Chem.*, 1933, **103**, 687.5. Shive, J. W. and Robbins, W. R., *Bull. New Jersey, Agri. Expt. Station*, 1942, 636.EFFECT OF HALOGEN-ION  
CONCENTRATION ON MILK COAGULATION BY PEPSIN

CLIFFORD<sup>1</sup> has shown that some of the halogen salts have an accelerating effect on milk coagulation by pepsin while others have an inhibitory effect. On the other hand, in the case of trypsin,<sup>2,3</sup> it was shown that whereas halogen salts greatly activate the milk coagulating activity of trypsin, the presence of these salts inhibits the coagulation of calcified milk by trypsin. Hence it was thought interesting to study the effect of some of the halogen salts on coagulation of calcified milk by pepsin.

The study was made by using milk with known calcium chloride concentration and studying the process of coagulation by pepsin in the presence of different concentrations of halogen salts. For these experiments, powdered milk was used as it was found to be a more reproducible substrate than fresh milk. One part of powdered milk by weight was dissolved in seven parts of water. To this milk, equal volume of 0.05 M, 0.035 M or 0.025 M solution of calcium chloride was added. Hence the concentrations of calcium chloride in milk were as listed in Tables I to III. The reaction mixture consisted of 10 ml. calcified milk, 2 ml. of halogen salt and 1 ml. of 2% pepsin. Hence the concentrations of halogen salt in the reaction mixtures were one-thirteenth of the recorded values. The reactions were followed at 37° C. in an incubator. It was found that during these reactions there were no fluctuations of pH which was Ca. 6.5. The results are summarised in Tables I to III, where time (in seconds) required for coagulation is given.

TABLE I

Concentration of  $\text{CaCl}_2$  in milk = 0.025 M

Concentration of halogen salt	NaCl	KCl	$\text{NH}_4\text{Cl}$	NaBr	KBr	$\text{NH}_4\text{Br}$
0.5 M	inst.	inst.	inst.	inst.	inst.	inst.
1.0 M	inst.	inst.	inst.	inst.	inst.	inst.
2.0 M	10	9	7	12	10	5

inst. = instantaneous.

TABLE II

Concentration of  $\text{CaCl}_2$  in milk = 0.0175 M

Concentration of halogen salt	NaCl	KCl	$\text{NH}_4\text{Cl}$	NaBr	KBr	$\text{NH}_4\text{Br}$
0.5 M	inst.	inst.	inst.	inst.	inst.	inst.
1.0 M	5	5	5	5	5	5
2.0 M	15	10	7	17	14	8

TABLE III  
Concentration of  $\text{CaCl}_2$  in milk = 0.0125 M

Concentration of halogen salt	NaCl	KCl	$\text{NH}_4\text{Cl}$	NaBr	KBr	$\text{NH}_4\text{Br}$
0.5 M	8	7	7	9	7	7
1.0 M	20	17	11	22	18	12
2.0 M	37	31	23	40	33	22

It can be seen that with the decrease in concentration of calcium chloride in milk, the inhibition of milk coagulation is increased. The increase in concentration of halogen salts also increases the period of inhibition. Thus the inhibiting effects of halogen salts on the coagulation of calcified milk by pepsin seem to be due to the increase of halogen-ion concentration in the solution. This increase in halogen-ion concentration appears to have a preferential effect on calcium ions thus inhibiting the formation of the intermediate compound-calcium parasasein-leading to the final coagulation.

Ammonium salts are comparatively less ionised. Naturally, the concentration of halogen ions is not so predominant in the case of ammonium salts and hence it can be seen from the results that the ammonium salts have a weaker inhibiting effect than sodium and potassium salts. Further work is in progress.

Dept. of Zoology, S. D. PISHAWIKAR.  
N. Wadia College, D. N. KAMAT.  
Poona, March 22, 1956.

1. Clifford, W. M., *Biochem. J.*, 1927, **21**, 544.

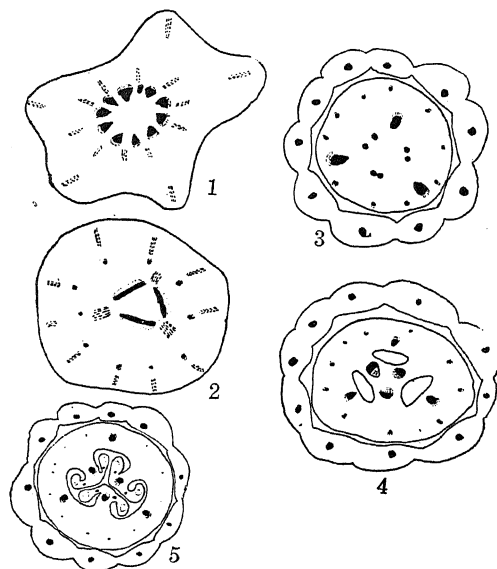
2. —, *Ibid.*, 1935, **29**, 1059.

3. Kamat, D. N., *J. Animal Morph. and Physiol.*, (in press).

### PLACENTATION IN *MELIA AZADIRACHTA* LINN. (*AZADIRACHTA INDICA* JUSS)

EXCEPTING a single account by Saunders<sup>1</sup> on *Melia azedarach* no other information is available with regard to the vascular anatomy of the flower in Meliaceae and therefore an investigation of the floral anatomy of the family was undertaken. The present note describes some features in the placentation of *Melia azadirachta*.

The receptacular stele after giving out the supply to the sepals and petals forms a continuous ring, and gives rise to a whorl of 10 traces (Fig. 1). At a slightly higher level



FIGS. 1-5. Semi-diagrammatic transverse sections of the flower of *Melia azadirachta* from the receptacle upwards (Perianth not shown),  $\times 10$ .

these traces divide radially into two parts (Fig. 2). The outer part enters the staminal tube while the inner divides and ramifies the ovary wall. The gaps formed by these traces are closed and the stele becomes triangular. Three traces—the carpellary dorsal traces—are given out from the angles of the triangular stele (Fig. 2). The residual stele in the centre consists of six bundles (Fig. 3) which fuse in pairs to form the inversely oriented placental bundles and they take a position in the septal radii (Fig. 4). At this level the ovary is trilocular. In the ovule-bearing region the placentas recede to the periphery as a result of which the ovary becomes unilocular (Fig. 5). The placental bundles after supplying the ovules fuse with the dorsals and extend into the style where they terminate below the stigma.

The placentation in *Melia azadirachta* has been described as axile in almost all taxonomic treatments. In his review on "Placentation in angiosperms", Puri<sup>4</sup> described and redefined various types of placentation and has pointed out that the position and composition of the placental strands are of great significance in the determination of placentation. In typical axile placentation the placental strands occur on the radii of the carpellary dorsals and are formed by two ventrals of the same carpel. But in parietal placentation they occur on radii alternating with the dorsals and are formed

by the ventrals of adjacent carpels. In *Melia azadirachta* it has been pointed out that the placental strands are on the septal radii. They are formed from the ventrals of two different carpels. Therefore anatomically the placentation is parietal in the plant under consideration.

Gundersen<sup>2</sup> strongly holds that parietal placentation is more primitive than axile placentation. On the other hand, Joshi<sup>3</sup> observes that every case of parietal placentation is derived from axile. Puri<sup>5-8</sup> has shown that parietal placentation in many families is derived from axile state. In *Melia azadirachta* and in other members of the family where parietal placentation occurs (author's unpublished observations) the placental strands are inversely oriented, a characteristic feature of axile placentation. This seems to indicate that the parietal placentation in the family Meliaceae is also derived from axile placentation and within the family there is a graded series from axile placentation to parietal placentation, a detailed account of which will be published elsewhere.

The author takes this opportunity to express his gratitude to Dr. B. N. Mulay for his guidance and encouragement.

Dept. of Botany,  
Birla College, Pilani,  
December 22, 1955.

N. C. NAIR.

1. Saunders, E. R., *Floral Morphology, a New Outlook with Special Reference to the Interpretation of the Gynacium*, 1937, 1.
2. Gundersen, A., *Bull. Torrey Bot. Club*, 1939, 66, 287-295.
3. Joshi, A. C., Presidential Address, *Bot. Sect., Indian Sci. Cong. 34th Session*, Delhi, 1947, Part II, 1-18.
4. Puri, V., *Bot. Rev.*, 1952, 18, 603-51.
5. —, *Proc. Nat. Acad. Sci. India*, 1945, 15, 74-91.
6. —, *Amer. J. Bot.*, 1947, 34, 562-73.
7. —, *Ibid.*, 1950, 37, 363-70.
8. —, *Phytomorphology*, 1954, 4, 278-99.

## RESPONSE OF SUGARCANE TO SULPHANILAMIDE

PLANT responses to sulpha drugs have been studied only in recent years, some of the effects recognised being depression of transpiration due to closure of stomata,<sup>1</sup> inhibited root growth<sup>2,5,6</sup> inhibited germination<sup>3,5,6</sup> and seedling growth<sup>6</sup> and increased root growth index.<sup>4</sup> Their effect on the p-amino-benzoic acid metabolism with labelled C<sup>14</sup> has also been studied,<sup>7</sup> the results having been largely contradictory in relation to plant species as also different drugs. In this note, results of preliminary pot

experiments on the effect of sulphanilamide on sugarcane is reported.

Pots having established sugarcane plants (under normal manurial application) were used in the experiments, the treatments being 0, 0.5, 1.0, 1.5, 2.0 and 2.5 g. of sulphanilamide per pot. Each pot contained 18 lb. of soil (Pusa calcareous loam). Records of growth, yield and juice quality data showed general improvement in cane height, leaf number, fresh weights of root, stem and whole plant, dry weights of sheath and root, moisture contents of leaf, sheath and whole plant, yield and juice quality (brix, sucrose and purity) resulting from sulpha drug treatments. The favourable effects on root growth and juice quality were quite marked. On the other hand the treatments tended to depress tillering, dry weights of leaf and stem and moisture content of stem.

Best performance in yield was recorded with a dosage of 1.0 g. per pot, juice quality being highest under the 2.0 and 2.5 g. treatments. Improvement in respect of the latter amounted to 4.6 units in sucrose % juice with a purity rise by as much as 17 units. Further large-scale experiments are in progress with a view to exploring the practical application of these findings.

The work was conducted as part of the Sugarcane Research Scheme in Bihar being financed jointly by the Government of Bihar and the Indian Central Sugarcane Committee to whom grateful thanks are due.

Central Sugarcane  
Res. Station,  
Pusa (Bihar),  
May 19, 1956.

M. S. SUBBA RAO.  
R. S. PRASAD.  
K. L. KHANNA.

1. Garo, F., *Arch. Soc. Biol.*, 1947, 32, 5.
2. Audus, L. J. and Quastel, J. H., *Ann. Bot.*, 1948, 12, 45.
3. Bustinza, F. and Ahvaro, D., *An. Inst. Espanol. Edafol. Scol. Y. Fisiol. Vegetal*, 1945, 4, 185.
4. Kumar, K. and Srivastava, K. C., *Proc. 40th Indian Sci. Cong.*, Part III, Abstracts, 1953, 116-17.
5. Bharadwaj, S. N. and Rao, I. M., *Curr. Sci.*, 1954, 23, 296.
6. Bharadwaj, S. N., *Proc. 41st Ind. Sci. Cong.*, Part III, Abstracts, 1954, 151.
7. Shiva Rama Krishnan, V. M. and Sharma, P. S., *Curr. Sci.*, 1955, 24, 330.

## MODE OF FEEDING BY PYRILLA

*Pyrilla* pierces a sugarcane leaf on its lower surface with its proboscis which consists of two tubes, one sliding inside the other. The outer tube which is formed by a pair of modified mandibles is on an average 797  $\mu$  long and 14.5  $\mu$  across while the inner one, consisting of

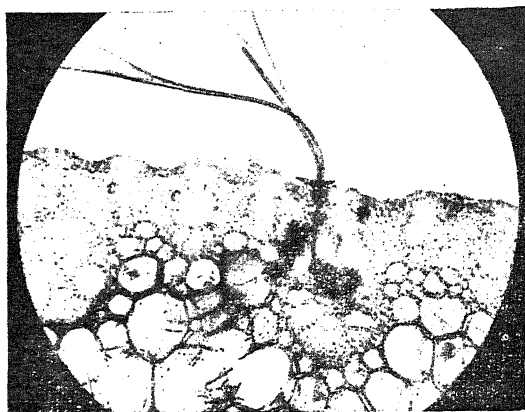


FIG. 1

FIG. 1. T.s. of midrib with a proboscis bent at right angles in soft tissue (phloem) to reach metaxylem,  $\times 40$ .

modified maxillæ is  $1,082 \mu$  in length and  $5.4 \mu$  in diameter. The proboscis breaks through the epidermis and does not seem to encounter much resistance from lignified sclerenchymatous sheath of even the largest vascular bundle. In the majority of cases the tip of the proboscis was found to rest in metaxylem from which *Pyrilla* evidently sucked its nourishment (Fig. 1). In this connection it is interesting to note that the proboscis was found bent at right angles in several cases without any apparent obstruction to the proboscis at the point of bending. In one case it formed almost a semi-circle (Fig. 2). Such sharp and abrupt change in the direction of proboscis-thrust could not have been brought about unless some factor like hydrogen-ion gradient was working as was found to be the case in sugar beet leaf-hopper.<sup>1</sup>

The parenchymatous cells along the passage of the proboscis were found to have elongated their contents taking stain with fast green. The elongation of the cells was very much similar to what was noted in connection with the reaction of young tissues of sugarcane stalk, when attacked by top-borer.<sup>2</sup>

Central Sugarcane  
Res. Stn.,  
Pusa, Bihar,  
April 11, 1956.

J. L. WAKHLOO.  
S. L. SHARMA.  
K. L. KHANNA.



FIG. 2

FIG. 2. T.s. of lamina with a proboscis bent twice so as to form a semi-circle,  $\times 100$ .

#### *PSEUDONAPOMYZA ATRA* MEIGEN (?) ON PADDY

Of the leaf-mining insects observed on paddy crop in the Indian Union, two deserve mention, viz., *Hispa armigera* Ol. and *Dactylispadilaticornis* Duv., whose grubs mine the paddy leaves. Both belong to the natural order Coleoptera. There has been however no record of dipterous leaf-miners attacking this crop in India. The authors, while engaged on the study of paddy insect pests at the Government Agricultural Research Station, Rudrur, and the Main Experimental Farm, Rajendranagar, in Hyderabad State, have observed since June 1952 the occurrence of an agromyzid leaf-miner. This has been tentatively identified as *Pseudonapomyza atra* Meig. (*Phytomyzinae*: *Agromyzidae*) and might probably be a synonym of *Phytomyza spicata* Mall., first described from Formosa in 1914. According to Swezey,<sup>1</sup> *P. spicata* mines the leaves of young maize, sugarcane and grasses in Hawaii. Frick<sup>2</sup> mentions that the maggots of *P. atra* Meig. mine the leaves of grasses in Europe and the United States of America. It appears to have a widespread distribution having been recorded from Europe, Africa, N. America, India, Malaya and the Pacific on a variety of graminaceous host plants.

The damage done to the paddy crop by *P. atra* Meig. consists of light-yellow apodous maggots mining the leaves and feeding on the mesophyll. The epidermal layers are not touched. The mines are linear but may turn into a blotch when more than one mine appear on the same leaf and spread over. The mines generally start from the tip of the leaf-blade

1. Fife, I. M. and Fremplon, V. L., *J. Agric. Res.*, 1936, 40.
2. Khanna, K. L. and Sharma, S. L., *Proc. Ind. Acad. Sci.*, 1948, 27 B, 1.

and progress towards the base. In case of severe infestation, the leaves wither and the tillering is affected adversely. In nature, the incidence is higher on the broadcast sown crop than on the transplanted crop. During August-September, which is the period of the maximal activity of the insect, routine sampling has indicated that in the broadcast crop, the range of attack varies from 15-50% while it is 1-10% in the transplanted crop. The length of the mine varies from 0.5" to 4.0". Generally not more than one maggot is observed in each leaf-mine. The pupation takes place inside the leaf-mines only. It may be mentioned here that according to published literature *P. atra* Meig. pupates in the soil, whereas *Phytomyza spicata* can either pupate in the soil or in the leaf-mine. The entire life-cycle of the insect is completed in 12-15 days. The adult flies are short-lived. In nature, the insect is kept in check by two chalcid parasites (under identification).

*Cynodon dactylon* is observed as the main host plant of the insect and cage studies with both *Cynodon* and young paddy reveal that the incidence is mostly on the former. Other grasses on which the insect is observed breeding are *Panicum crus galli* Linn., *Setaria intermedia* R. & S., *Eleusine* sp. and *Eragrostis pilosa* B.

Recently a scheme for the study of this leaf-miner, jointly financed by the Indian Council of Agricultural Research, New Delhi, and Hyderabad Government has been put into operation to study the potentialities of the insect and to evolve suitable control measures.

Sincere thanks of the authors are due to Dr. W. J. Hall, Director, Commonwealth Institute of Entomology, London, for the identification of the insect and help rendered by way of supply of references and to the Professor of Botany, Agricultural College, and Research Institute, Coimbatore, for identifying some of the plant specimens mentioned in the note.

Division of Entomology, M. Q. KHAN.  
Dept. of Agriculture, D. V. MURTHY.  
Hyderabad, June 21, 1956. A. S. RAO.

1. Swezey, O. H., *Hawaii Plant Rec.*, 1940, 44, 151; (*R.A.E.*, 29A, 331).
2. Frick, K. E., *California University Publications in Entomology*, 1952, 8 (8), 339-452.

# A NEW SPECIES OF *CERCOSPORA* ON AN ECONOMIC HOST

DURING his studies on the genus *Cercospora* of the Bombay State, the author encountered a grove of silver oak (*Grevillea robusta* A. Cunn.)

at Mahabaleshwar during the cold weather severely affected by a leaf-spot, caused by a species of *Cercospora*. The plants showed extensive irregular laminar necrotic areas resulting in defoliation. Since no *Cercospora* is known on this host, the fungus is presented here as a new species.

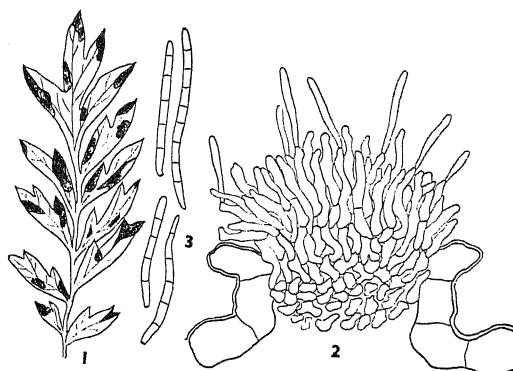


FIG. 1. Effects on host. (2) Conidiophores. x 860.  
(3) Conidia. x 860.

*Cercospora agharkari* Chiddarwar, spec. nov. Foliorum maculae intraque pagina, irregulares, brunneae, in inferiore pagina fuscae brunneae, in superiore vero fructificationibus ad medium ornatae. Infectio ut plurimum ad margines foliorum circumscripta. Fructificationes amphigenae, emergentes per cellulas epidermales; conidiophori ut plurimum compacti, plures, brunnei, paulum divergentes, ut plurimum non-septati, raro semel septati, rectis vel tenuiter curvatis, marginibus undulatis, latitudine uniformi, apice tenuiter rostrato, cicatricibus indistinctissimis, apicalibus, generatim una, raro duplici vel triplici,  $15.3-42.4 \times 2.5-4.2 \mu$ . Stromata bene evoluta, brunnea, cellulis irregularibus, compatis, diam.  $42.5-156.0 \mu$ . Conidia profusa, cylindrica vel acicularia, ad basim subobtusata, recta vel tenuiter curvata, septis indistinctis, 1-9, ut plurimum 3-6, cicatrice indistincta,  $20.4-75.5 \times 2.1-3.4 \mu$ .

Typus lectus in foliis *Grevilleae robustae* A. Cunn. in loco Mahabaleshwar, mense januario anni 1956 a P. P. Chiddarwar.

The species is described after Dr. S. P. Agharkar in recognition of the many services rendered by him to botany.

Grateful acknowledgements are due to Prof. M. N. Kamat, under whose guidance the work was carried out, and to Prof. H. Santapau for Latin diagnosis.

M. A. C. S. Lab., P. P. CHIDDARWAR.  
Poona-4, April 13, 1956.



### MEIOTIC STUDIES IN *ADIANTUM PERUVIANUM* KLOTZ.

To study the interrelationships among the different species of the genus *Adiantum*, cytogenetic investigations in this genus have been taken up. While a full account will have to await detailed studies of the species and their hybrids, it may be worthwhile to give a preliminary account of such of these species which show some cytological irregularities. Several local species of *Adiantum* have been studied, but only *A. peruvianum* Klotz. shows some meiotic irregularities, an account of which is given here.

For cytological examinations, young sori were fixed in acetic-alcohol for 2-3 hours and squashed in acetic or propionic carmine with a drop of ferric chloride as mordant which gave excellent results. Three of the local species have so far been investigated cytologically. The species *Adiantum capillus-veneris* L. and *Adiantum caudatum* Linn. regularly form 30 bivalents at metaphase and the anaphase separation is also regular. The species *Adiantum peruvianum* Klotz., however, shows some irregularities in meiosis. The somatic chromosome number in all the three species is, of course, 60. Squashes from several plants of this species were prepared and all of them showed the same meiotic behaviour. At first metaphase of meiosis there were 4-10 univalents in different cells with a mean of 6.6 per cell, and 25-28 bivalents with a mean of 26.72 per cell (Fig. 1). At anaphase the univalents lag behind (Fig. 2)

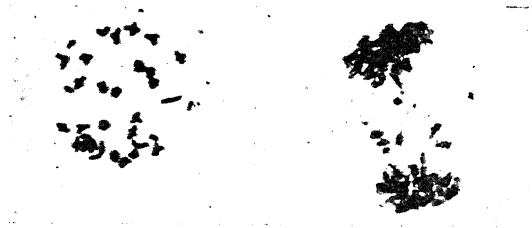


FIG. 1

FIG. 2

FIG. 1. Late Diakinesis in a spore mother cell of *Adiantum peruvianum* Klotz. showing 27 II + 6 I.

FIG. 2. First anaphase division in a spore mother cell of *A. peruvianum*, showing 8 lagging univalents.

and by the time all the other chromosomes have been included in the telophase nuclei the univalents are left outside. Thus the two nuclei formed at first division of meiosis do not seem to have the same number of chromosomes. Presumably, as a result of this irregularity in meiosis the spores that are formed are of two

types in each sporangium (Fig. 3). It may be seen that some of the spores are almost round with a regular wall while the other type of spores are triangular with a shrunken wall, the latter type being conspicuously smaller in size than the one which are round. It is likely that the spores which are round and big have either full set of 30 chromosomes or more, while the shrunken spores perhaps arise from the nuclei which have less number of chromosomes. The actual number of chromosomes in these two types of spores and the types of prothalli they would give rise to are under investigation. It may, however, be mentioned that Kachroo and Nayar,<sup>1</sup> have reported underdeveloped and shrunken spores in *Adiantum peruvianum* Klotz. and they found that the prothalli formed from these shrunken spores were deformed and did not develop to maturity. But no light was thrown on the probable cause for the formation of the two types of spores. It may be added that the other two species *Adiantum capillus-veneris* L. and *Adiantum caudatum* Linn. in which meiosis is quite regular have only one type of spore in each sporangium (Fig. 4).

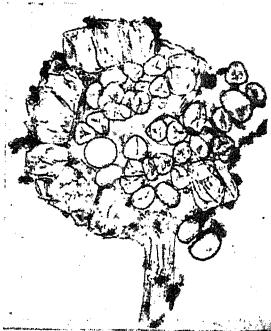


FIG. 3

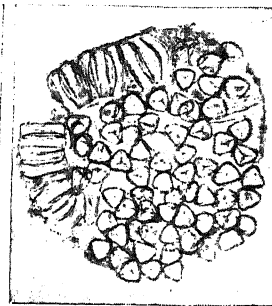


FIG. 4

FIG. 3. A sporangium of *A. peruvianum* showing spores of different shapes and sizes.

FIG. 4. A sporangium of *A. capillus-veneris* L. (with regular meiosis) showing spores of only one type.

In each sporangium, as described above, most of the spore mother cells at meiosis showed normal number of chromosomes, i.e., 60 chromosomes, some as univalents and the rest as bivalents. But occasionally spore mother cells with double the number of chromosomes, i.e., 120 were observed. The details about the origin of these giant mother cells are under investigation. In these giant mother cells several quadrivalents but no univalents were observed. It seems, therefore, quite likely that at certain stage during differentiation of some of the spore

mother cells, chromosome number is doubled, possibly due to incomplete mitosis (as described by Mehra,<sup>2</sup>) or non-functioning of the spindles at the pre-meiotic mitosis. The high frequency of bivalents in spore mother cells with normal chromosome complements suggests that most of the chromosomes are homologous, hence the formation of quadrivalents in the giant mother cell is understandable. As a result of the doubling of the chromosome, each non-homologous chromosome which remains as univalents in the normal spore mother cells, gets a partner, hence the absence of any univalents in the giant mother cells is also explicable. However the ultimate fate and role of these giant mother cells is not yet known.

From the foregoing it seems likely that *A. peruvianum* Klotz. might have arisen as an interspecific hybrid between two very closely related 60 chromosome species, and is maintained in nature due to the germination of well-developed spores which occur here and there in the sporangium along with the large number of shrunken spores. The robust habit, large size of the leaf, pinna (Fig. 5) and spo-



FIG. 5

FIG. 5. (A) A rachis of *A. peruvianum* Klotz.

(B) A rachis of *A. capillus-veneris* L.

Note the difference in habit and size of rachis, pinna and sori.

rangia in this species in comparison to other species may also be due to hybrid vigour. However the details of these morphological and other evidences will be published later.

Dept. of Botany,  
Patna University,  
Patna-5,

R. P. ROY.  
BAXI M. B. SINHA.

1. Kachroo, P. and Nayar, B. K., *Phytomorphology*, 1953, **3**, 240.
2. Mehra, P. N., *Proc. Nat. Acad. Sci.*, 1944, **14B**, 189.

## CHROMOSOME NUMBER OF A PIGMENTED *ANNONA SQUAMOSA* L.

A NEW type of *Annona*, locally known as *Red Sitaphal*, was found in the vicinity of Bala-nagar, Mahboobnagar District of Hyderabad State, by the Horticulturist to the Government of Hyderabad. The type is characterised by red stem, red pericarp and red mesocarp. The seed set of this type is normal. Being red-coloured it attracts special attention in the market.

Actively growing root tips of *red sitaphal* were fixed and stained in crystal violet. The chromosome counts are based on the maximum number of metaphase plates. The chromosome number was found to be  $2n=14$ . A pair of SAT-chromosomes was also seen which was attached to the nucleolus. The chromosome numbers of the species of *Annona*, so far reported, are as follows:

*A. cherimolia* Mill<sup>1</sup>—14; *A. muricata* L.<sup>1</sup>—14;  
*A. reticulata* L.<sup>4</sup>—14, *A. squamosa* L.<sup>1</sup>—14;  
*A. glabra* (Palustris)<sup>4</sup>—28.

The present workers are not aware if reports on SAT-chromosomes have so far been made. The existence of a pair of SAT-chromosomes would suggest that the species is basically a diploid one.

The chromosome number of ordinary white *Sitaphal* (*Annona squamosa* L.) was also determined, by the same technique as described above, and found to be  $2n=14$ , thus confirming the findings of Kumar and Randive<sup>1</sup> and Islam<sup>2</sup> and not 16 as reported by Bowden.<sup>3</sup> It may be that the latter counted the two satel-lited portions as two chromosomes and hence reported the number as 16. From the present work and that reported by earlier workers it would appear that the basic number of the genus *Annona* is 7. The taxonomic status of the new type, *Red Sitaphal*, is being studied by the Horticulturist, Hyderabad.

The authors wish to acknowledge Shri L. Venkatratnam, Horticulturist to Government of Hyderabad, for supply of seed.

Govt. Main Expt. Station, M. S. PAWAR.  
Rajendranagar, D. S. BORGAONKAR.  
Hyderabad-6, June 1956. S. A. KULKARNI.

1. Kumar, L. S. S. and Randive, K., *J. Univ. Bombay*, 1941, **10 B**, 31, 8.
2. Islam, A. S., *Curr. Sci.*, 1953, **22**, 118.
3. Bowden, W. M., *Amer. J. Bot.*, 1945, **32**, 81-92.
4. Janaki Ammal, E. K. (seen from Darlington, C. D. and Janaki Ammal, E. K.), *Chromosome Atlas of Cultivated Plants*, 1945, George Allen & Unwin, London, pp. 397.

## REVIEWS

Niels Bohr and the Development of Physics.

Edited by W. Pauli. (Pergamon Press, London), 1955. Pp. vii + 195. Price 30 sh.

This volume contains a series of ten essays by older and younger collaborators and friends of Professor Niels Bohr, and is intended to be a *Festschrift* presented to him on the occasion of his seventieth birthday. Each author has reviewed the progress in his special field, and the various chapters together form a fairly connected survey of the development of atomic and nuclear physics, particularly as regards physical concepts and mathematical theory. Darwin has written on the development of the concept of atomic number in Rutherford's laboratory. Heisenberg, Landau, Rosenfeld and Klein deal respectively with the interpretation of quantum mechanics, the quantum theory of fields, quantum electrodynamics and relativistic quantum mechanics. Pauli has contributed an article on the exclusion principle and its generalisation to Dirac's ideas of electrons and positrons. Casimir has discussed the essential requirements of any theory of superconductivity, and has brought out certain aspects of the phenomenon which, though well-known in principle, has not received proper attention. Nuclear physics is represented by the two articles by Friedman and Weisskopf on the compound nucleus and by Wheeler on nuclear fission and nuclear stability.

It is no wonder that the articles in this volume cover practically the whole of atomic and nuclear physics, for Niels Bohr has been intimately connected with every one of the major developments in these subjects during the last 50 years. Almost every worker in these fields has had his inspiration from Niels Bohr, and the *festschrift* is a most fitting tribute of their admiration and gratitude. The volume will no doubt be read with great interest by every student of modern physics.

Structure Reports. Vol. 9 for 1942-44. General Editor: A. J. C. Wilson. (Published for the International Union of Crystallography by N. V. A. Oosthoek's Uitgevers Mij, Utrecht), 1956. Price D. Fl. 65.

*Structure Reports* are intended to give practically complete information of structural interest in papers published during the period of review. Vol. 10 has been reviewed in this

journal. The aim of the editors at present is to bridge the gap between the last volume of *Strukturbericht* and the present date. So far Vols. 10 to 13 covering the period 1945-50 have appeared.

The arrangement of items is not alphabetical nor according to structure type, because neither could be rigorously followed. The structures are in fact arranged in the order of increasing complexity, related structures being put together. This arrangement is certainly very useful, for it is often necessary to refer to compounds related to that in which one is interested. Four indexes are given: a subject index, a general formula index and another one specially for organic compounds and an author index. Although not claimed to be fully exhaustive, the reviewer has found them to be perfectly satisfactory. A separate section gives references to work published during 1942-44 but abstracted in other volumes of *Structure Reports*.

One cannot but admire the thoroughness with which the *Reports* have been prepared, and particularly the fact that a number of obscure journals and also journals devoted to quite different fields and which contain only a small amount of information of structural interest have been searched in preparing them. A few errors have been noticed, e.g., the journal in references 2 and 3 on p. 403 should be *Proc. Nat. Acad. Sci. U.S.A.* and not *Proc. Amer. Acad. Sci.* In the case of Russian authors, great trouble has been taken in transliterating the names. However, it is regrettable that the names of many Indian authors have been misquoted with either wrong spelling, or giving quite arbitrarily either the first name, second name or third name in the index, e.g., Bisheshwar Dayal is given as D. B(i)sheshwar, Devi Datt Pant as D. P. Devi, K. Sunanda Bai as B. K. Sunanda while Anna Mani is given correctly as A. Mani. Other errors are Bhagavant(a)m, Sha(n)ker and Harihara(n). It would be better if the last names are always given in the index, with the initials of the other names, as is the usual practice followed for instance in *Science Abstracts*. It would also be desirable to give the language of a paper if it is not in either English, French or German, so that the interested reader may obtain a translation instead of a photostat copy, if he is not familiar with the language.

These comments do not in any way detract from the value of these *Reports* which should find a place in every laboratory devoted to structures and solid state physics.

G. N. RAMACHANDRAN.

**Microscopy of Ceramics and Cements.** By Herbert Insley and Van Derck Frechette. (Academic Press), 1955. Pp. 286.

Amongst the indispensable tools of the geologist and the mineralogist the microscope retains its supreme position, and its importance has not been overshadowed by the application of the X-ray, the differential thermal analysis techniques or by the recent introduction of the electron microscope to such studies. The silicate industries concerned with the utilization of earthly materials, although started mainly as arts, have during the last four decades made remarkable advances as a result of the organised application of microscopy to industrial operations. In the understanding of their raw materials and finished products, the microscope has played a very significant role, which is clearly brought out in this book. No doubt, there are already several comprehensive textbooks dealing with the microscope and its application to the study of minerals, but treatises dealing particularly with ceramic materials are not many. The above publication, written by two well-known investigators in this fascinating field of technology is therefore welcome.

There are 15 chapters in the volume and the first four are devoted to a general survey of the subject including the description of the microscope, the technique, the sampling, etc., which though well-known, should serve as a useful and ready reference to the investigator. In Chapter 5, the authors give in a few pages special techniques and it would have been more helpful if this chapter had been expanded a little. The remaining ten chapters deal with raw materials and diverse types of finished products, namely, whitewares, refractories, glass, cements porcelain enamels, structural clay products, foundry sands, slags and abrasives. The plan of dealing with the different branches of ceramics in separate chapters and illustrating with specific examples is convenient. In American parlance glass is included under ceramics and in that respect the inclusion of a chapter on glass in this book (although covering only ceramics and cement) is very helpful, since in recent years the application of the microscope to the study of the defects in glass, particularly stones, cords,

striae, etc., has been extremely useful. The selection of the examples has been judicious; so also the several tables and diagrams giving characteristics of the crystal systems and the basis of optical determinations. With the rapid advances that are taking place in the field of silicate technology by the application of fundamental knowledge, this book will be very useful to the advanced students, the research worker and the factory technologist. The detailed bibliography and incorporation of subject and authors' index enhance the value of this well-presented book.

A. R.

**Physics of Fibres.** By H. J. Woods. (Physics in Industry Series.) (Published by the Institute of Physics, London), 1955. Pp. 100. Price 30 sh.

Natural fibres like cotton, jute and silk have been in use from time immemorial, but a real understanding of their physical and chemical nature has come only in recent years. One result of such fundamental studies has been the production of a large number of man-made fibres like rayon and nylon, which could be made with just the properties needed for any special purpose.

The common feature in all fibres is the occurrence of long chain-molecules, in which relatively simple chemical groups are joined together end to end to give a molecular unit, containing some hundreds or thousands of such groups. The book under review is essentially concerned with the physical methods of studying the properties of such fibres and understanding the nature and structure of the long molecules occurring in them.

The first chapter gives a short account of the supra-molecular structure and the types of inter-atomic forces involved in bringing the molecules together to form the fibrous structure. The second chapter deals with some of the macroscopic physical properties of fibres, which are of interest to the technologist. The four succeeding chapters deal with the physical techniques adopted for a study of the internal structure—X-ray diffraction, optical methods, elastic properties and electron microscopy. While the basic principles of the methods and the types of information that one may expect to obtain from them are given clearly, it is unfortunate that the examples have all been selected from too narrow fields, namely, cellulose and keratin. This is particularly so with X-ray diffraction and electron microscopy, where a number of other fibres have been extensively studied.

The book is well suited to the novice needing an introduction to the field of fibre physics. The references are quite extensive, as far as cellulose and keratin are concerned. The monograph can also be recommended to scientists working in other fields, but who wish to learn about the applications of physical methods to the study of fibres. The price of 30 sh. however appears to be excessive for a monograph of only 100 pages. G. N. RAMACHANDRAN.

**Iron Ores of India.** By M. S. Krishnan. (Published by the Indian Association for the Cultivation of Science, Jadavpur, Calcutta-32.) Pp. 177. Price Rs. 5.

While the characters and distribution of iron ore deposits in India have been known through the publications of the Geological Survey of India, an authoritative book exclusively devoted to the Iron Ores of India is a great need that has recently assumed special significance in view of the setting up of three steel plants in the country. The present publication represents three lectures given by the eminent author as Ripon Professor of the Indian Association for the Cultivation of Science in July 1953. It might perhaps be added that two special volumes under the same authorship have recently come out from the Geological Survey of India entitled, "Iron and Steel" and "Iron Ores of Salem".

The nature of iron, the diverse minerals in which it is represented in nature and their origin, together with a classification of the iron ore deposits, form the introductory part of the book. It is of considerable interest that some space has been given to mineral beneficiation and, in particular, to the treatment of low grade iron ores. The history of iron and steel in general and the manufacture of iron and steel in India in bygone days make extremely interesting reading as also the early struggle and the unsuccessful attempts to establish a modern iron and steel industry in India. The main part of the book deals at great length with the geological distribution of iron ores in the country and a detailed account of occurrences in the different States of India along with the analyses of all ores. A valuable indication of the proved reserves of iron ores in India has been made and these proved reserves of all types of ores in India stand at 6,421 million tons, while possible reserves may be estimated at 21,240 million tons. A brief account is given of the iron and steel industry in India as at present, with a note on the future of the industry. The author rightly observes, "A large

increase in iron and steel production in the country will not only prevent the heavy drain of the monetary reserves for procuring them from outside but will contribute to rapid progress in many ways—in industrialisation, in the strengthening of the defences of the country and in the raising of the general standard of living of the people" (p. 159). This book should prove a valuable asset to all interested in iron ores and the iron and steel industry in India. N. R. SRINIVASAN.

**Chemical Engineering. Vol. II. (Unit Operation.)**

By J. M. Coulson and J. F. Richardson. (Pergamon Press, London), 1955. Pp. xvi + 387-975. Price 60 sh.

The basic principles of chemical engineering, namely, fluid dynamics, heat and mass transfer were discussed in Vol. I, and it is the application of these principles that form the subject-matter of this volume. The various unit operations discussed have been classified and grouped according to the mechanism of the operation.

Sections A to D having already been dealt with in Vol. I, this volume starts with Section E and deals with the flow of fluids through granular beds and packed columns, filtration and centrifugal separation. The later chapters are particularly good and contain some fine line drawings and photographs which help in a large measure to the proper understanding of the subject.

Section F, on systems involving relative motion between a fluid and particles, deals with (a) motion of particles in a fluid, (b) sedimentation, fluidisation and converging, (c) gas cleaning.

Section G, on mass transfer in chemical engineering, begins with a comprehensive treatment of leaching, with a good description of various methods of calculation, and elucidating the same with worked problems. Distribution, incidentally the longest chapter in the book, has been dealt with remarkably well, perhaps the best that can be found in any general chemical engineering book. Absorption and liquid liquid extraction have also received equally good treatment.

Section H deals with operations involving heat transfer, viz., evaporation, crystallisation and drying. The last section deals with the mechanical operations of size reduction and classification of solids and miting. There are a good many line drawings and photographs of crushing and grinding machinery and mixing

equipment. The chapter on classification of solids could have been given a little more detailed treatment.

The authors (both of them Professors of Chemical Engineering), have out of their long teaching experience, produced a book, that will not only be popular with chemical engineering students, but also with those in industry. The excellent line drawings and photographs of commercial equipment are some of the finest that have ever been published to explain what goes on inside them and greatly enhance the value of the book. The material is up-to-date, with special emphasis on basic mathematical treatment. Adequate reference to literature has been given at the end of each chapter. A list of 121 problems given at the end of the book will prove to be very useful.

In the words of the authors, "The essence of chemical engineering is the understanding of the design and construction of chemical plant", and the present two volumes have certainly contributed materially in achieving the ideal.

M. G. SUBBA RAU.

---

International Review of Cytology. Vol. IV.  
Edited by J. F. Danielli and G. H. Bourne.  
(Academic Press), 1955. Pp. vii + 419. Price  
\$ 9.00.

For the past one decade cytologists have become acutely aware of the existence of isolated pockets of knowledge as a consequence of highly specialized researches. The contribution by Kopac on "Cytochemical Micrurgy" in the volume under review could be taken as an example. The aim of these researches is stated to be the measurement of the activities of certain enzymes not only in single cells but also in parts of cells (p. 25). They are designed to check the validity of the results obtained by the simpler methods, but the cost of instruments and the high skill necessary would deter their becoming routine procedures. This is just one instance of extreme specialization. In such a situation the avowed object of the Editors to emphasize the unity of cytology in the volumes of the *International Review of Cytology* is rather reassuring.

As a part of the general programme there are two reviews on special cell types, viz., "Amœbocytes" by Wagge and "Goblet Cells" by Moe. There is a continuation of the discussions on redox pump mechanisms for ionic transport by Conway. Choline esterases at

neuromuscular junctions is reviewed by Cou-teaux.

Recent studies on plant mitochondria are highlighted by Hackett, especially as regards their close similarity to animal mitochondria. It is refreshing to note the emphasis that the cell as a whole and not the mitochondria should be the real unit in any analysis of the activities of a cell.

Advances in our knowledge of the structure of the chloroplasts is discussed by Mühlethaler. The frontiers have been extended by the use of the electron microscope. Guilliermond's suggestion that plastids are descended from mitochondria has been replaced by the thesis that proplastids as distinct from mitochondria exist in the cytoplasm.

Wolmen discusses the problem of fixation and remarks: "Different appearances of the same structures studied by different methods do not necessarily mean that one of the methods elicits the formation of artifacts". . . . "There are no good universal fixing agents any more than there are universally good stains".

The review of the structure and chemistry of the nucleoli by Vincent is highly interesting. The suggested importance of nucleic acids in cell metabolism has resulted in extensive researches on the histochemistry of nucleic acids. Kurnick evaluates the present position and concludes that "histochemical analyses for nucleic acids should be regarded as primarily qualitative and interpretations based upon quantitation must be viewed with caution" (p. 261).

Ideas are yet to crystallize regarding the cytological architecture of bacteria. Vendrely, summarizing the present position of the histochemistry of bacteria, considers that in the present state of our knowledge "we can only stress the complexity of the problems and the great interest of their future developments" (p. 138).

The most thought-provoking essay is that of Marshak on "Bacterial Cytology". "The whims of fashion have again brought the bacterial nucleus into prominence, not only as judged by the volume of words about it appearing in the literature, but apparently also in the thinking of bacteriologists not formerly accustomed to giving it much consideration". . . . "We find the same words (chromosomes, centrioles, nucleolus, mitotic process) being applied now, as in the past, to images obtained by staining procedures not very different from those used 20-30 years ago". However, he concludes that sufficient points of resemblance exist between

the chromosomes of higher organisms and the chromatinic bodies of ordinary bacteria.

The volume would be a welcome addition to any library.

M. K. SUBRAMANIAM.

**The Non-Ferrous Metal Industry in Europe.** (Published by the Organisation for European Economic Co-operation, 2, rue Andre'-Pascal, Paris-16 ), 1956. Pp. 92. Price 7 sh.

The publication reports on the situation in the non-ferrous metals industry in Europe in 1954 and the first half of 1955, and has been prepared by the Non-Ferrous Metals Committee of the Organisation for European Economic Co-operation. After a general introduction, the report details factors in the supply and demand of aluminium, copper, lead, zinc, tin and nickel in the 17 member countries and indicates fluctuations and future developments. To cite an instance it is pointed out that world capacity of aluminium should reach 3.5 million tons by 1956 compared to 2.5 million tons in 1954 and even then "it is unlikely that supply will increase sufficiently to relieve the pressure of demand". The text includes diagrams and tables on the various metals and the appendix records the figures for individual countries. Such annual reviews by specialised organisations are welcome as they would help in planning the production and consumption of non-ferrous metals in the countries of the region.

N. R. SRINIVASAN.

## Books Received

**Acridines—Chemistry of Heterocyclic Compounds**, Vol. 9. By R. M. Acheson. (Interscience Pub.) (Agents in India: Asia Publishing House, Ballard Estate, Nicol Road, Bombay), 1956. Pp. xii + 409. Price \$ 12.50.

**Enzymes—Units of Biological Structure and Function.** (Henry Ford Hospital International Symposium.) Edited by O. H. Gaebler. (Academic Press), 1956. Pp. 624. Price \$ 12.00.

**Common Cultivated Crops of South India.** By V. T. Subbiah Mudaliar. [Amudha Nilayam (Private) Ltd., 91, Mount Road, Madras-18], 1956. Pp. xvi + 606. Price Rs. 15.

**Enzymes and Metabolism—Cori Anniversary Volume**, Vol. 20, No. 1. (Cleaver Hume Press), 1956. Pp. 287. Price 47 sh. 6 d.

**Pharmacopœia of India.** (Ministry of Health, Government of India, New Delhi), 1955. Pp. xxiv + 1001. Price not given.

**Gaseous Nebulæ**, Vol. 3. By L. H. Aller. (Chapman & Hall), 1956. Pp. xvi + 322. Price 63 sh.

**Frequency Calculations—Practical Solution of Torsional Vibration Problems**, Vol. I. Third Edition Revised. By W. Ker Wilson. (Chapman & Hall), 1956. Pp. xxxii + 704. Price 5 guineas net.

**Disposal of Sewage**, Third Edition Revised. By T. H. P. Veal. (Chapman & Hall), 1956. Pp. xii + 208. Price 30 sh.

---

## SCIENCE NOTES AND NEWS

---

### Sulphur Deposit in Rup-Ganga Valley

Mr. B. S. Tewari, Dept. of Geology, Lucknow University, states that during the Rupkund Expedition led by Prof. D. N. Majumdar, Head of the Anthropology Department, Lucknow University, he has discovered a promising deposit of native sulphur from Piti Udiar (79° 39' : 30° 15' 30") in the valley of the Rup-Ganga in the neighbourhood of Bhanela Forest Plantation, about 30 miles east of Nandprayag (79° 19' : 30° 20').

The mineral is powdery in nature but occasionally stalactitic. The extractable sulphur content varies from about 58% to 60.7%. The deposit occurs at an altitude of about 8,000' above sea-level. A mule track already exists between Nandprayag and Sutol—a village close

to this deposit. Even recently, it is said, the deposit was exploited locally for the preparation of gun-powder. The deposit, though apparently small, may yield sulphur of high purity and is being taken up for investigation in detail.

### *Centranthera humifusa* as Hemi-root Parasite

Sri. S. L. Sharma, Sri. D. Rao and Sri. J. N. Jha, Central Sugarcane Research Station, Pusa, write that *Centranthera humifusa* which occurs in Bengal, Deccan Peninsula, Ceylon, Java, Borneo and Malaya and in the eastern part of Chotanagpur in Bihar, has not been recorded as a hemi-root parasite so far. Plants of this species differ from those of *C. nepalensis* in

having yellow flowers with purple markings in the corolla tube. They are on the whole smaller in size, and flower appreciably earlier than *C. nepalensis*. The colour of seed is darker in *C. humifusa*. Like *C. nepalensis* (Sharma et al., Curr. Sci., 1954, 23, 128) it was found to attack the roots of sugarcane, *Cynodon dactylon* and *Imperata arundinacea* in Kharagpur (Monghyr District) in September 1955.

#### Isolation of Invertebrate Hormones

Dr. K. K. Nayar, Dept. of Zoology, University College, Trivandrum, observes :

The success in isolation and purification of some invertebrate hormones was announced at the symposium on invertebrate endocrinology held at Sorbonne in July 1955. The details of the papers are awaiting publication in *Ann. des Sciences nat.*

Prof. Karlson of Tubingen reported the isolation of the crystallised principle of the developmental hormone in insects. Extracted from the prothoracic glands of *Bombyx mori*, it was found to be chemically different from any known vertebrate hormone, and the name *ecdysone* was proposed for it. This was demonstrated to be the hormone bringing about moulting or ecdysis in insects.

Drs. Ostlund and Fange of Lund announced their success in isolating, in a chemically purified form, the chromatophorotropic principle from the eyestalks of the crustacean *Pandalus borealis*. They have suggested *Leander* as an ideal animal for biological tests and have proposed "Leander units" in the assay of the hormone.

#### Soviet Journal of Atomic Energy

The Board of Editors of the *Journal of Nuclear Energy* and Pergamon Press, London W.1, have announced that with the co-operation of the USSR Academy of Sciences, arrangements have been made to publish as a supplement to the *Journal of Nuclear Energy* a *verbatim* translation of *Atomnaya Energiya*, the Soviet Journal of Atomic Energy.

The first issue of *Atomnaya Energiya* will be published in August as part of the *Journal of Nuclear Energy*, which, in order to accommodate the increasing number of papers being submitted, will commence monthly instead of bi-monthly publication.

The subscription rate to the *Journal of Nuclear Energy* will be £ 7 or \$ 2.00 per volume. Three volumes will be published a year.

#### Bibliography of Botany in Western India

The Botanical Survey of India, Western Circle, is undertaking the preparation of an up-to-date bibliography of botany for the whole of Western India, which embraces the States of Rajasthan, Saurashtra, Cutch, parts of South-Western Punjab, Gujarat, Maharashtra, Bombay, Karnatak, Mysore, parts of Madras, Hyderabad, Coorg, and Travancore-Cochin.

Authors of papers relating to the botany of this region are requested to send their reprints for inclusion in the Bibliography to: Dr. G. S. Puri, Regional Botanist, Botanical Survey of India, Western Circle, Poona-4.

#### Indo-Canadian Technical Co-operation

One hundred and sixty trainees from India have proceeded to Canada, since the inception of the Colombo Plan, for advanced training. The subjects of training include medicine, dentistry, microbiology, ophthalmology, engineering, agriculture, geology, plant pathology, nursing, electrolytic chemistry and many other subjects. Those who are working within the Departments of the Canadian Government or Canadian companies are studying subjects like hydro-electric project, thermal electric projects, road-building, pulp and paper industry, manufacture of tin containers or the manufacture of electrical equipment. Some of the more exotic studies include helminthology, the storage of human and animal eyeballs, heart surgery or poultry pathology. Canada will also train the Indian technical personnel in working the N.R.X. high-powered research reactor that is being set up at Bombay with Canadian assistance under Colombo Plan. Besides seven Canadian experts are at present assisting India in small-scale industries, public health, engineering and nursing.

#### Manufacture of Streptomycin

Preliminary plans for the setting up of a streptomycin plant in the penicillin factory at Pimpri have been drawn up. The scheme envisages the manufacture of 15,000 to 20,000 kilograms of streptomycin per year and a number of leading firms have been asked to state the terms and conditions on which they would be prepared to collaborate in the project.

#### IX International Congress on Rheumatic Diseases

The Ninth International Congress on Rheumatic Diseases will be held at Toronto, Ontario, Canada, from June 23 to 28, 1957. This



quadrennial function of La Ligue Internationale contre le Rheumatisme will be held under the auspices of the Canadian Rheumatism Association. The Programme Committee invites contributions to the scientific programme of the Congress and is anxious to receive reports on current clinical or basic research dealing with any aspect of the rheumatic diseases.

Those offering papers for consideration should submit a 200 to 300 word abstract in triplicate not later than the 1st of January 1957. All correspondence should be directed to: The Ninth International Congress on Rheumatic Diseases, Post Office Box 237, Terminal "A", Toronto, Ontario, Canada.

#### Prof. C. Mahadevan

Prof. C. Mahadevan who has been abroad for an year as UNESCO Expert in Geology for the development of Amazonia, has returned after a period of useful service in Brazil. Reconnaissance surveys carried out by him in Amazonia has brought to light new and rich mineral sources, while he was also instrumental in co-ordinating the work of the Amazon Planning Commission with 'Petrobras', the organisation dealing with development of petroleum resources in Brazil and 'Prospec', the aero-photographic company registered in Brazil, for the purpose. Perhaps the most basic work was in connection with the devising of ways and means for the educational training of geologists, which the Government of Brazil has accepted and experts to give effect to shortly. His efforts abroad have been very appreciatively received by UNESCO Headquarters and UNTAB.

#### Chemistry at Poona University

A new wing has been added to the Chemistry Department of the Poona University, which was opened by the Prime Minister on August 1. The Government of India have agreed to pay two-thirds of the cost to complete the building by the addition of lecture halls.

Thanks to the generous donation of rupees three lakhs from the Government of India, the laboratory is equipped with up-to-date apparatus and equipment for research and training of post-graduate students in X-ray diffraction, magnetochemistry, ultrasonics, dielectric constants, electrochemistry, absorption and fluorescence spectra, optical dispersion, microchemistry, chromatography, polarography, chemistry

of sugar and gur, enzymes and chemical instrumentation. There are at present more than a hundred students in the post-graduate classes from all over India, and over fifty research papers have been published both in India and abroad.

#### Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Physics to Kumari V. Santhamma for her thesis entitled "Some Theoretical and Experimental Spectroscopic Investigations on Certain Polyatomic Molecules"; and the D.Sc. Degree in Technology to Shri V. V. G. Krishnamurthy for his thesis entitled "Studies in Phase Equilibria and Spray Tower Performance at High Flow Rates".

The Utkal University has awarded the Ph.D. Degree in Chemistry to Shri S. C. Sircar and Shri P. K. Jena for their theses on the behaviour of some uni-bivalent, bi-univalent and bi-bivalent salts in aqueous solution.

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri T. R. Ingole for his thesis entitled "Studies in Naturally Occurring Carbohydrates".

#### Photometry of Telescopes and Binoculars

The photometric performance of telescopes and binoculars is determined by measurements of light transmission, veiling glare index and field brightness. Light transmission is given as the percentage of light transmitted in the central part of the field of view. Veiling glare is a measure of the light scattered or reflected in the instrument which, falling on the image, reduces its contrast. From brightly illuminated clouds in the field of view, for example, so much light may be scattered in the instrument that an observer may find it practically impossible to locate or recognize a target. Field brightness gives a measure of the falling off in illumination towards the edges of the field of view.

Notes on Applied Science No. 14 "Photometry of Telescopes and Binoculars" (published by H.M.S.O. for the D.S.I.R., price by post 2 sh. 1½ d.) describes apparatus developed at the National Physical Laboratory, Teddington, U.K., for making these three measurements. Full details of the apparatus and methods of use are given. Apparatus to the N.P.L. design can be obtained commercially.

# Current Science

Vol. XXV]

SEPTEMBER 1956

[No. 9

	PAGE		PAGE
<i>Atomic Energy Development in India</i> ..	277	<i>Dr. L. A. Ramdas</i> .. ..	283
<i>Expanding Universe</i> .. ..	278	<i>Letters to the Editor</i> .. ..	284
<i>Fast Neutron Radiation and Localised Chromosome Breakage</i> —M. S. SWAMI-NATHAN AND A. T. NATARAJAN ..	279	<i>Reviews</i> .. ..	305
<i>Synchronous Micronuclear Divisions in Multimicronucleate Ciliates</i> —B. R. SESHACHAR AND P. B. PADMAVATHI ..	281	<i>Chemical Applications of Spectroscopy</i> —R. S. KRISHNAN .. ..	308
		<i>Science Notes and News</i> .. ..	309

## ATOMIC ENERGY DEVELOPMENT IN INDIA\*

THE Geneva Conference on the Peaceful Uses of Atomic Energy was a most significant event for the scientifically less advanced countries, for it has made it possible for them to make progress in this field with very much less effort and expense than has been required of the more advanced countries during the last fifteen years. We owe a great debt to those countries which so wholeheartedly placed before this Conference the knowledge which they had gained through such strenuous efforts and at such great cost.

The Indian programme in the field of atomic energy, modest as it is, has made considerable progress during last year. The planning of the Atomic Energy Establishment at Trombay has been completed and construction work has started. The capacity of the thorium plant has been increased several fold, and a plant for producing natural fuel elements for future reactors is being set up. The first atomic re-

actor of the swimming pool type became critical on August 4, and is now undergoing its trial runs.

A reactor of the NRX type was generously offered by Canada last year, and the modifications which would have to be made to allow for the difference in environmental conditions of Trombay and Chalk River (Canada) have been worked out and are being finalised. In this connection it is a pleasure to recall the hearty manner in which Canadian scientists co-operated to adapt the reactor to the changed environment and improve it for research and other purposes. A location for the reactor in Trombay has been decided upon and excavation, foundation and building work are in progress.

A formal agreement between the Governments of Canada and India was signed in New Delhi in April of this year, under which Canada will make available the reactor proper, while India will be responsible for its erection and provision of the associated laboratory.

The reactor will be housed in a hermetically sealed steel shell, so that in case of accidents

\* Summary of a broadcast talk from the A.I.R. in the field of Atomic Energy given by Dr. H. J. Bhabha, Director, Atomic Energy Establishment.

radioactivity does not leak into the atmosphere. The reactor is expected to go into operation in the first half of 1958, and in the spirit in which the reactor has been offered, India will make the facilities of this reactor available for the use and benefit of scientists from other countries in Asia and beyond. The heavy water for the reactor has been made available by the United States, without any conditions being attached, except that it should be used only in connection with research for peaceful purposes, a condition which is readily acceptable.

It may be mentioned that studies have been completed for the construction of a large fertilizer plant where substantial quantities of heavy water may be made as a by-product, and construction work on the project will start shortly. The possibility of making heavy water at the large Government-owned fertilizer plant at Sindri has been investigated, and a decision to make heavy water there will be taken shortly. The circumstance that India requires large amounts of ammonium sulphate or nitrate as fertiliser, coupled with the fact that substantial quantities of this fertiliser will be produced in State-owned plants offers possibilities for producing considerable quantities of heavy water as a by-product.

It may be added that India is an active member of the International Atomic Energy Agency mooted by President Eisenhower at the end of the Geneva Conference last year, and participated in a working level meeting in Washington to prepare a draft Statute for the Agency. This draft Statute is to be considered by an International Conference of some 80 countries to be held in New York in September this year. A number of problems on which there were considerable differences of opinion seem to have

been satisfactorily solved at the Washington meeting, and it is expected that those that remain will be ironed out in the New York Conference.

Ending on a serious note, which is readily understandable in view of the political and economic implications of atomic energy, Bhabha observes: "The matter which causes India and many other States very considerable concern is the severity and far-reaching nature of the Article relating to Safeguards. Precautions against misuse are naturally necessary and must be taken. But they must be approached in a spirit of reality. The proposed safeguards requiring accountability for the source materials, uranium and thorium, when supplied by the Agency, in a world in which thousands of tons of these materials are sold from one country to another, avowedly for use in military programmes, are clearly unfair and arouse the fear in many that the result, if not the intention, will be to create a uranium cartel. Fissionable material will be the future fuel for electric power generation in the world, and to require such material to be turned over to the Agency by countries receiving aid is to give the Agency power to interfere in the economic life of such countries. We must not let fear and suspicion and an illusory hope of making a foolproof system drive us into the position where the main purpose of setting up the Agency is throttled. But there is no doubt that if the International Agency is approached with the same courage, vision and trust, as the Atomic Energy Conference in Geneva last year, we shall have taken a most important step towards establishing a secure peace and a rich and prosperous future for mankind."

## EXPANDING UNIVERSE

**S**UBSTANTIAL new evidence that the universe is expanding at the same rate in all directions has been obtained in a recently completed 20-year co-operative study by astronomers at the Mount Wilson-Palomar Observatories and the University of California's Lick Observatory. The conclusions are derived from the red-shifts of more than 800 extra-galactic nebulae, or galaxies, in the universe beyond the Milky Way.

When interpreted as velocities of recession, red-shifts provide the observational material for relativity theories of the expanding universe. So

far, uniform expansion of the universe has been inferred from relatively few observations of red-shifts, for adequate experimental data have not been available prior to the completion of the present study, which consequently is of fundamental importance in astronomy.

A report has been published in the *Astronomical Journal* by M. L. Humason and A. R. Sandage of the Mount Wilson-Palomar Observatories, and N. U. Mayall of Lick Observatory. The programme to determine red-shifts was formulated in 1935 by the late Edwin Hubble.

# FAST NEUTRON RADIATION AND LOCALISED CHROMOSOME BREAKAGE

M. S. SWAMINATHAN AND A. T. NATARAJAN

Indian Agricultural Research Institute, New Delhi

IT is of interest while studying the cytological effects of radiations to determine whether breaks occur at random in the chromosomes, or whether certain points are specially liable to be broken. Such studies can be carried out only in favourable material where certain chromosomes can be marked and their division cycle separately followed. Ford *et al.*<sup>1</sup> have recently used chromosome markers in the study of the problem of regeneration of particular groups of cells in mice. The present paper deals with certain observations on the effects of fast neutron radiation on mitosis in root tip cells of *Triticum monococcum* (var. Japanese Early) using a pair of satellited chromosomes as markers.

Dry seeds of *T. monococcum* were irradiated for 3 hours with fast neutrons of source strength  $10^9$  neutrons/cm.<sup>2</sup>/sec. (approx.) over a  $2\pi$  solid angle from the cascade generator of the Tata Institute of Fundamental Research, Bombay, using the reaction  $d(Be^9B^{10})\alpha$ . The seeds were germinated in petri dishes at 24°C. and the effects of the treatment on somatic chromosome division were studied in Feulgen root tip squashes of material fixed in acetic alcohol (1:3) without any pre-treatment 24, 72 and 96 hours after germination. Preparations from untreated *T. monococcum* seeds germinated and fixed in a similar way, served as controls.

The control preparations showed the normal division figures characteristic of *T. monococ-*



FIG. 1. A normal somatic complement of *T. monococcum* ( $2n = 14$ ). Arrows point to Sat. II pair which have been used as markers in this study. FIG. 2. Neutron treated root tip cell showing 3 Sat. chromosomes intact ( $\rightarrow$ ) and one Sat. II chromosome broken near the supernumerary constriction region in the short arm ( $\rightarrow$ ). (Magnification of photographs,  $\times 1800$ .)

In the normal chromosome complement of *T. monococcum*, there are two pairs of satellite-bearing chromosomes, one of which is somewhat longer than the other (designated Sat-chromosome I and II; relative lengths  $12.6\mu$  and  $10.4\mu$  respectively). Among the remaining five pairs of chromosomes, the centromere is submedian in position in 4 pairs and median in the other. In the short arm of the satellited chromosomes, there is a weak supernumerary constriction. These chromosomes are readily recognisable in well-spread plates (Fig. 1) and hence were used as markers in the following study.

*cum*. In the material treated with neutrons, cell division proceeded without inhibition. At prophase and metaphase of the dividing nuclei, many chromosome breaks and interchanges were seen. Other cytological aberrations included the presence of bridges and fragments at anaphase and micronuclei at telophase and formation of occasional polyploid nuclei. Some cells showed clumping at metaphase and bridges at anaphase due to a surface stickiness caused by the deposition of nucleic acid on chromosomes in a fluid unpolymersed state,

Only chromosome breaks occurred at metaphase and no chromatid breaks could be identified. The frequency of occurrence of chromosome breakages was analysed in 315 metaphase plates; in 210 of these, no breaks were seen and in the rest the number of breaks per cell varied from 1 to 20. The relative frequency with which cells containing different numbers of breaks were found, follows Poisson distribution thus indicating that the formation of a chromosome break is unaffected by the presence or absence of other breaks in the cell.

In preparations made from material fixed 24 hours after germination, a critical study of the types and points of origin of breaks could be done in 64 clear metaphase plates. The analysis showed that a break frequently occurred near the supernumerary constriction region of one chromosome belonging to the Sat. II pair (Fig. 2). The frequency of occurrence of this particular break and the total number of breaks observed in different cells are listed in Table I. Breaks in the Sat. I pair were noticed in 7 cells. Only in two cells which had 20 chromosome breaks, both the Sat. II chromosomes were affected in the same region. Some breaks also occurred in the distal part of the Sat. II chromosomes. None of the other fragments, however, showed the recurrence characteristic of the proximal break in one of the Sat. II chromosomes.

TABLE I

Description	No. of cells	No. of localised breaks in Sat. II	Total No. of breaks
Regular	.. 11	0	0
One chromosome break	.. 20	9	20
Two chromosome breaks	.. 21	12	42
Three do	.. 5	2	15
Four do	.. 2	1	8
Five do	.. 2	1	10
Six do	.. 1	1	6
Twenty do	.. 2	4	40
TOTAL	.. 64	30	141

The total chromosome length in a somatic complement of *T. monococcum* was calculated to be  $172.2\mu$ , of which the length of the Sat. II pair was  $20.8\mu$ . If chromosome breakages following neutron radiation are caused completely at random, the chances for any one of the observed breaks to occur in the Sat. II chromosomes will be proportional to their length in the complement. On this basis, approximately

one in every 8.3 breaks could occur in the Sat. II chromosomes. The observed figure of 30 out of a total of 141 breaks does not, however, fit with this expectation ( $\chi^2 = 11.30$ ;  $P < 0.01$ ). This would suggest that the region near the supernumerary constriction of Sat. II chromosomes is preferentially disposed to breakage by neutron radiation. There was no evidence in preparations made 24, 72 and 96 hours after germination of the occurrence of a general restitution, and hence the results may not be attributable to non-random reunion and restitution of broken fragments instead of to non-random breakage. It is not possible to determine by microscopical observations whether the breakage always occurs only in one particular chromosome of the Sat. II pair. The occurrence of a single Sat. II break in most of the cells suggests that some degree of differentiation with reference to localised neutron sensitivity may occur in the apparently homologous pair of chromosomes. Also, if the particular break in a Sat. II chromosome occurs at random among the pair, a break in both the chromosomes can be expected to occur in 25% of the cells which show a Sat. II break. Only two among the 28 cells with Sat. II breaks showed breakage in both the chromosomes ( $P$  between 0.05 and 0.02). Thus, localised breakage appears to occur in only one chromosome of the pair and not at random in either of them.

From the results so far reported in literature, it appears that breaks produced by radiations both between different chromosomes and along the same chromosome are generally distributed at random. The position is, however, quite different with regard to chemical mutagens. Observations by Ford<sup>2</sup> and others in *Vicia faba* have clearly shown that the heterochromatic regions of chromosomes are more susceptible to damage by radiomimetic chemicals like Nitrogen Mustard than the euchromatic parts. There are indications that the heterochromatic regions of chromosomes may also be more sensitive to breakage induced by radiation with X-rays, ultraviolet rays and gamma rays.<sup>3,4</sup>

In both slow and fast neutron irradiated material, chromosome breaks have usually been assumed to occur at random. Konzak and Singleton<sup>5</sup> have, however, very recently found that different endosperm factors in chromosome 9 of maize respond quite differently to thermal neutron radiation, thus indicating some basic difference in the breakability of chromosomal regions. The results of the present study provide for the first time cytologi-

cal evidence for the existence of a non-random sensitivity of chromosome segments to fast neutron action. Examination of chromosomes in root tip cells subjected to cold treatment did not reveal the presence of any prominent heterochromatic segment in the region where breakage frequently occurs. In case the non-random breakage is confined to only one of the Sat. II chromosome pair, as seems likely from our data, it may suggest the presence of a sub-microscopic differentiation between the homologous pair of chromosomes at the vulnerable region. In a similar study carried out in the same variety of *T. monococcum* using  $\beta$  radiation from  $^{32}\text{P}$ , we found no evidence for a preferential susceptibility to breakage of any segment in either Sat. II or the other chromosomes. Thus, it would appear that the local-

ised breakage caused by fast neutron radiation is probably a correlated consequence of the specific properties of the neutron particles and the concerned chromosome segment.

We are indebted to Dr. B. P. Pal and Dr. S. M. Sikka for their interest and advice. We are very grateful to the Tata Institute of Fundamental Research, Bombay, and Dr. R. Ramanna for irradiating the seeds with neutrons.

1. Ford, C. E., Hamerton, J. L., Barnes, D. W. H. and Loutit, J. F., *Nature*, 1956, **177**, 452.
2. Ford, C. E., *Proc. 8th International Genetic Cong. Hereditas Suppl.*, 1949, 570.
3. Barton, D. W., *Cytologia*, 1954, **19**, 157.
4. Moutschen, J. and Govaerts, J., *Nature*, 1953, **172**, 350.
5. Konzak, C. F. and Singleton, W. R., *Proc. Nat. Acad. Sci.*, 1956, **42**, 78.

## SYNCHRONOUS MICRONUCLEAR DIVISIONS IN MULTIMICRONUCLEATE CILIATES

B. R. SESHACHAR AND P. B. PADMAVATHI

Dept. of Zoology, Central College, Bangalore

**B**INARY fission is a recognizable phenomenon in the life-cycle of all protozoa, where the nucleus as well as the cytoplasm divide more or less simultaneously. In all euciliates where nuclear dimorphism occurs, there is an amitotic macronuclear system and a mitotic micronuclear system. In multimicronucleate forms the behaviour of the micronuclei during binary fission is very striking. There is synchronous division of all the micronuclei in the system. Similar examples are presented by d'Arcy Thompson<sup>1</sup> and Sonnenblick<sup>2</sup> in the fertilized insect egg where synchronization of nuclear divisions is seen for many generations. Apparently chemical situations identical throughout a syncytium induce nuclear divisions.<sup>3</sup> Such a type of synchrony is induced under experimental conditions by Darlington and Mc Leish<sup>4</sup> in the endosperm cells after X-radiation. Intermittent heat treatment to cultures of *Tetrahymena* resulted in synchronous cell division.<sup>5</sup> Apparently enzymatic processes operating in the cell system are highly sensitive to temperature change, producing widely different responses. Such induced chemical disturbances acting on cell metabolites must lead to synchronous cell division.<sup>6</sup>

*Frontonia leucas* is a multimicronucleate ciliate where, under normal laboratory conditions, all the micronuclei divide synchronously

preparatory to cell division. Fig. 1 shows all the micronuclei in telophase. An essentially similar but less striking phenomenon is seen in *Oxytricha bifaria* where also the micronuclei exhibit a striking synchrony in their divisions (Fig. 2). On the other hand, in *Spirostomum ambiguum*, another multimicronucleate ciliate, the situation is different. Of the numerous (often a hundred) micronuclei in the animal, only 20-30 proceed to divide while the others remain in the resting condition (Fig. 3). It would be worthwhile to know the kind of selectivity responsible for the initiation of division in only a few micronuclei in *Spirostomum*.

In *Frontonia* and *Oxytricha*, there is harmony between synthesis and cell division. On the contrary, the fertilized egg represents an extreme case of competition between synthesis and cell division. In the ovary there is no division, only synthesis; but once fertilization occurs, synthesis is completely suppressed in the ovum and the emphasis is on the cell division which takes place in rapid succession. In its normal cell cycle, every growing and dividing cell switches to and from these two extremes of cell phenomena. The situation is altered by external agents like chemicals in the medium<sup>7</sup> or temperature.<sup>5</sup> But in *Frontonia* the stimulus for synchronous nuclear division is internal even as in

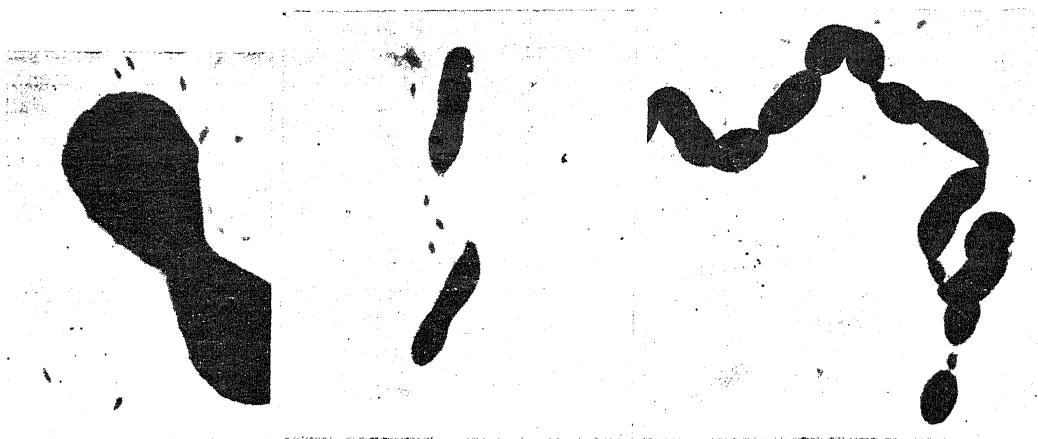


FIG. 1. Part of *Frontonia leucas* showing synchronous division of the micronuclei. The macronucleus shows a constriction. Feulgen,  $\times 1,000$ .

FIG. 2. *Oxytricha bifaria* showing synchronous division in the four micronuclei. Feulgen,  $\times 1,000$ .

FIG. 3. Part of *Spirostomum ambiguum* showing ten micronuclei in the "crescent" stage. A few micronuclei in the resting condition are also found. The macronuclear beads are coming together preparatory to fission. Feulgen,  $\times 1,000$ .

*Spirostomum* the selectivity must be due to a cytoplasmic chemodifferentiation.<sup>8</sup> These cytological events must be mere expressions of more deep-seated biochemical mechanisms under the guidance of either external stimuli<sup>4,5</sup> or internal stimuli as in *Frontonia*, *Oxytricha* and *Spirostomum* and the insect egg.<sup>1,2</sup> Only these internal stimuli may be of more than one kind, manifesting itself now in synchrony (*Frontonia*, *Oxytricha*) and now in selectivity (*Spirostomum*). It seems entirely impossible to determine the nature of this stimulus. The physiological gradients of Hammerling,<sup>9,10</sup> the cytoplasmic chemodifferentiation hypothesis of Waddington,<sup>8</sup> the plasmagene-like factors of Spiegelman,<sup>11</sup> the physical intermolecular electronic hypothesis of Lwoff<sup>12</sup> or the kinetosome theory of Weisz<sup>13</sup> are only a few of the plausible explanations.

We need now to form some idea of the physiological processes in cells which underlie these phenomena. We are forced to picture some sort of a dynamic system responding to the environment, involving both the nucleus and the cytoplasm, or an interaction of nuclear

and cytoplasmic cyclical dependency as described by Waddington.<sup>8</sup>

1. Thompson, d'Arcy, W., *On Growth and Form*, 1942, Cambridge University Press.
2. Sonnenblick, B. P., *In the Biology of Drosophila*, edited by Demerec, 1950, John Wiley and Sons, New York.
3. Hotchkiss, R. D., *Proc. Nat. Acad. Sci.*, 1954, **40**, 49.
4. Darlington, C. D. and Mc Leish, *Heredity*, 1954, **8**, 385.
5. Zeuthen, E. and Scherbaum, O., *In Recent Developments in Cell Physiology*, 1954, edited by J. A. Kitching, (Butterworth, London).
6. Ephrussi, B., *Nucleocytoplasmic Relations in Microorganisms*, 1953, Oxford University Press.
7. Darlington, C. D. and Koller, P. C., *Heredity*, 1947, **1**, 187.
8. Waddington, C. H., *Symp. Soc. Exp. Biol.*, 1948, **2**, 145.
9. Haemmerling, J., *Arch. Entomoch. Org.*, 1934 a, **131**, 1.
10. —, *Ibid.*, 1934 b, **132**, 424.
11. Spiegelman, S., *Cold. Spr. Harb. Symp. Quant. Biol.*, 1951, **16**, 87.
12. Lwoff, A., *Problems of Morphogenesis in Ciliates*, 1954, J. Wiley & Sons, New York.
13. Weisz, P. B., *Quart. Rev. Biol.* 1954, **29**, 207.

DR. L. A. RAMDAS

DR. L. A. RAMDAS, Deputy Director-General of Observatories (Climatology and Geophysics), retires from the India Meteorological Department on superannuation on 3rd October 1956. Dr. Ramdas began his career as a Palit Research Scholar from 1923-26 under Sir C. V. Raman and discovered the phenomenon of the 'Scattering of Light by Pure Liquid and Sound Surface'. He conducted several fundamental investigations on surface phenomena, scattering of light by gases and other optical phenomena. He was awarded the Doctorate Degree in Physics of the Calcutta University. He was the first to obtain in 1928 the 'Raman Effect' in the case of a vapour (ether vapour).

He joined the India Meteorological Department in September 1926 and spent his first five years in the then fresh field of Aviation Meteorology and researches in Micro-climatology, a hitherto unexplored subject.

In 1932, when the Indian Council of Agricultural Research inaugurated the Scheme of Agricultural Meteorology, an entirely unexplored field of research of the greatest importance to Indian Agriculture, Dr. Ramdas was chosen for the task of organising and developing the new Division of Agricultural Meteorology at the Meteorological Office, Poona. In this capacity he was actively engaged on fundamental researches in micro-climatology, crop-climates, heat and moisture balances near the ground, soil moisture, plant relationships, radiation balance near the ground, statistical researches into crop-weather relationships, and work on many borderland problems in physics, meteorology, soil physics, plant physiology, etc. The results of these many investigations have been discussed in a series of more than 250 original papers and reports which have won for India a leading place in the field of Agricultural Meteorology. They have been widely quoted or referred to in standard publications on the subject.

In 1953, Dr. Ramdas assumed charge of the post of Deputy Director-General of Observatories (Climatology and Geophysics) at the Meteorological Office, Poona, in which capacity he was in general charge of the Climatological, Geophysical and Agricultural Meteorological programmes of the India Meteorological Department. During the period 1953-56, he carried out

interesting researches on various aspects of the South-West Monsoon, the winter depressions which affect the weather over North India during the winter season and the micro-climates of buildings. During this period, he officiated as the Head of the India Meteorological Department for a short period.

Dr. Ramdas has a high reputation in Indian scientific circles and is a prominent member in most of the scientific bodies in India related to Physics, including Atmospheric Physics and Agricultural Meteorology. He presided over the Physics Section of the Indian Science Congress at the Patna Session in 1948 and was awarded the M.B.E. by the previous (British) Government of India in 1946 for his pioneer researches in Agricultural Meteorology.

He is also a member of many International Bodies, some of which he has attended as Delegate and taken active part. He attended the Ninth Assembly of the International Union of Geodesy and Geophysics at Brussels in 1951 as the Chief Delegate of India. He is a member of the Radiation Commission of the IUGG since 1949. He attended the first session of the Agricultural Meteorology Commission of the World Meteorological Organisation held at Paris in 1953 and presided over the Committee which dealt with all technical and scientific items. He was a member of the Indian Delegation to the Pan Indian Ocean Science Congress held at Perth (West Australia) in August 1954, where he delivered two lectures on Long Range Forecasting and Micrometeorology respectively. He has been now invited by the UNESCO to take part in the forthcoming Symposium on Arid Zone Climatology with special reference to Micro-climatology to be held in Canberra (Australia) from 17th to the 24th October 1956.

Dr. Ramdas is primarily a physicist who has had always a band of Post-Graduate research students working under his guidance. He has also for the last 10 years carried out and continues even now advanced investigations in infra-red spectroscopy under a Research Scheme financed by the Council of Scientific and Industrial Research with the aid of two Research Assistants provided by the Council. We hope that he will be continuing his scientific work with undiminished enthusiasm and energy.



## LETTERS TO THE EDITOR

	PAGE		PAGE
<i>Simultaneous Signal Strength Measurements on Continuous and Pulsed Radio Wave Transmissions Reflected from the Ionosphere</i> —B. RAMACHANDRA RAO AND K. V. V. RAMANA .. .. .	284	<i>Pseudomonas tuticorinensis</i> N. Sp., A Marine Denitrifying Bacterium—A. SREENIVASAN AND R. VENKATARAMAN ..	294
<i>Unit Cell and Space Group of Aluminium Acetylacetonate and Cobalt Acetylacetonate</i> —P. G. KHUBCHANDANI .. .. .	285	<i>Occurrence of Nodal Galls on Sugarcane</i> —M. Q. KHAN, D. V. MURTHY AND S. K. SASTRY .. .. .	295
<i>Slowing Down of Neutrons in Beryllium from 1.44 ev. to Thermal Energy</i> —K. S. SINGWI AND L. S. KOTHARI ..	286	<i>Variations in the Development of Pro-embryo in Utricularia coerulea</i> L.—S. B. KAUSIK AND M. V. S. RAJU ..	296
<i>An Efficient Solubility Apparatus</i> —G. ARAVAMUDAN AND K. R. KRISHNASWAMI	287	<i>A Male Sterile Mutant in N. tabacum</i> —N. R. BHAT AND T. KRISHNAMOORTHY ..	297
<i>Preparation of Ceric Acetate in the Anhydrous State and Its Photo and Thermal Decompositions</i> —D. PATNAIK AND S. PANDA .. .. .	287	<i>A New Bacterial Leaf-Spot on Phaseolus trilobus</i> —V. V. BHATT, S. G. ABHYANKAR AND M. K. PATEL .. .. .	299
<i>Conversion of Histidine to Urocanic Acid in Germinating Seeds</i> —V. M. SIVARAMA-KRISHNAN AND P. S. SARMA .. .. .	288	<i>Pythium catenulatum</i> Matthews Causing Sugarcane Seedling Root Rot—K. V. SRINIVASAN .. .. .	299
<i>Occurrence of Haemagglutinins in Calf Vaccine Lymph</i> —V. N. KRISHNAMURTHY	289	<i>Spontaneous Variegated Chimæra in Dianthus chinensis</i> L.—C. M. BASTIA AND G. PANIGRAHI .. .. .	300
<i>Sickle Cell Trait in Some Tribes of Western India</i> —P. K. SUKUMARAN, L. D. SANGHVI AND G. N. VYAS .. .. .	290	<i>A Thermostatically Controlled Miniature Glass-House</i> —T. S. SADASIVAN, (MISS) L. SARASWATHI-DEVI AND (MISS) C. B. SULOCHANA .. .. .	301
<i>Anatomical Defects of the Reproductive Organs in Cattle Found in Uttar Pradesh</i> —MAHENDRA PRATAP JOHARI ..	291	<i>Soil Application of 2, 4-D to Increase Sugar in Cane</i> —A. S. CHACRAVARTI, D. P. SRIVASTAVA AND K. L. KHANNA ..	302
<i>Condition Factor in Some Fishes of Lucknow, Uttar Pradesh</i> —S. K. MOITRA ..	292	<i>Nematode Galls on a Grass Dicanthium annulatum</i> —D. BAP REDDY .. .. .	303
<i>A Fermentation Process for the Production of Quality Fish Meal</i> —V. KRISHNA PILLAI .. .. .	293	<i>Metamict Hematite</i> —M. D. KARKHANAVALA	303
		<i>A Large Overthrust Structure Near Debi-pur (Barakar), West Bengal</i> —D. N. RATH, S. RAMARATNAM AND S. B. KAR ..	304

# SIMULTANEOUS SIGNAL STRENGTH MEASUREMENTS ON CONTINUOUS AND PULSED RADIO WAVE TRANSMISSIONS REFLECTED FROM THE IONOSPHERE

RAWER<sup>1</sup> compared noon-time ionospheric absorption data at two stations, Freiburg and Slough, 400 Km. apart, for a period of 26 months and observed that the mean amplitudes obtained at the two stations vary similarly. Subsequently Beynon and Davies<sup>2</sup> conducted a series of experiments in one of which they compared the day to day changes in the intensity of the signals received from distant short wave broadcast senders and vertical incidence iono-

spheric signals from a pulse transmitter radiating on an equivalent frequency. They observed that, in general, there is a quite close correlation between the monthly mean values of the two signals, the correlation coefficient obtained in summer being smaller due to sporadic E ionisation. No attempt has been made so far to study the extent of correlation between the short time variation of pulse and CW signals extending over a day. The authors have taken up the comparative study of the signal strength variations of oblique incidence CW and vertical incidence pulse signals over a short period of about an hour during afternoon every day with a view to find out the extent of correlation existing between them.

The experimental technique adopted in this investigation is conventional. Transmissions from A.I.R. station at Madras radiating on a frequency of 9.54 Mc/s. on the short-wave band have been chosen for obtaining the CW field strength records on an Esterline Angus pen recorder. The vertical incidence signal strength records were taken on a conventional ionospheric sounding equipment consisting of a pulse transmitter and receiver operating on a frequency of 3.15 Mc/s. which is the equivalent vertical incidence frequency for reflections from the E layer at a height of 110 Km. It is observed that during the period of recording the operating frequency is always lower than the critical frequency of the E layer. A good number of records taken during the months of May and June in the afternoon hours were analysed statistically for finding out the correlation coefficient between the signal strength variations in the two records. The pulse signal strength records were taken on single hop reflections from the E region. The following table gives the values of the correlation coefficients thus obtained for six typical days, along with the date and duration of the record.

TABLE I

Sl. No.	Date	Duration of the record	Correlation coefficient
1	21-5-1955	1630 to 1651	0.61
2	24-5-1955	1621 to 1644	0.45
3	2-6-1955	1627 to 1659	0.51
4	14-6-1955	1600 to 1632	0.27
5	22-6-1955	1605 to 1632	0.54
6	27-6-1955	1602 to 1630	0.61

It will be seen that the average coefficient is as high as 0.5. To illustrate the extent of correlation visually a graph is drawn showing the variation of mean signal strengths of pulsed and continuous radio waves with time for a record taken on 21-5-1955 and is reproduced in Fig. 1. The general similarity between these

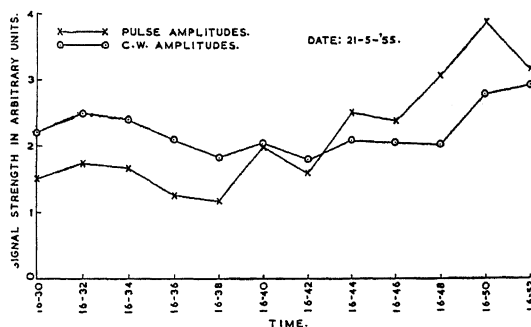


FIG. 1

curves shows that the major absorption which occurs in the lower D-layer is also responsible for the short time variations in the signal strength. The general trend of increase in the signal strength in both the records towards evening is due to the decrease in the D-layer absorption. It is significant to note that the average correlation coefficient obtained here is higher than that reported by Beynon and Davies for summer months in spite of the high activity of sporadic E at this place during these months. Further work is in progress.

Ionospheric Res. Labs., B. RAMACHANDRA RAO.  
Andhra University, K. V. V. RAMANA.  
Waltair, June 20, 1956.

1. Rawer, K., *J. Atmos. Terr. Phys.*, 1951, 2, 38.
2. Beynon, W. J. G. and Davies, K., *Ibid.*, 1954, 5, 273.

#### UNIT CELL AND SPACE GROUP OF ALUMINIUM ACETYLACETONATE AND COBALT ACETYLACETONATE

ASTBURY<sup>1</sup> has taken rotation pictures of both aluminium acetylacetonate and cobalt acetylacetonate. He has determined the cell parameters of both to show the isomorphous nature of the monoclinic acetylacetonates.

During the course of other investigations in this Establishment, it became necessary to make an X-ray examination of the two acetylacetonates. The cell constants have been determined by rotation, followed by Weissenberg photographs and are given in Table I.

	Aluminium acetylacetonate	Cobalt acetylacetonate
$a_0$	13.88 Å	14.13 Å
$b_0$	7.53 Å	7.53 Å
$c_0$	16.14 Å	16.12 Å
$\beta$	98°30'	98°30'

The cell parameters determined here from Weissenberg photographs agree well with those reported by Astbury from rotation photographs. From the systematic absences in the  $0k0$  and  $h0l$  series, the space group for both has been confirmed to be  $P2_1/c(C_{2h}^5)$ .

Chemistry Division, P. G. KHUBCHANDANI.  
Atomic Energy Establishment,  
Bombay, July 16, 1956.

1. Astbury, W. T., *Proc. Roy. Soc.*, 1926, 112A, 449.

### SLOWING DOWN OF NEUTRONS IN BERYLLIUM FROM 1.44 eV. TO THERMAL ENERGY

THE slowing down age of neutrons in moderators like beryllium and graphite is calculated using Fermi's continuous slowing down theory which is only valid so long as the neutron energy is large compared with the binding and thermal excitation energies of the moderating nuclei. In the low energy region, Fermi's theory breaks down and has to be replaced by a quantum theory. Neutrons of energy greater than that corresponding to the Debye temperature of the moderator, lose their energy to the lattice by emitting multi-phonons. When the neutron energy is only slightly greater than the equilibrium energy, it slows down through processes in which both emission and absorption of phonons are important. The slowing down of neutrons in this energy region has not been satisfactorily studied so far. We report here some of the results of our calculations on the slowing down of neutrons in beryllium from 1.44 eV. to thermal energies. The details will be published elsewhere.

For neutron energy  $E < 2k\theta_D$ ,  $\theta_D$  being the Debye temperature ( $1,000^\circ\text{K}$  for Be) and  $k$ , the Boltzman constant, we have used the Debye model of the solid to calculate the elastic and inelastic scattering cross-sections<sup>1</sup> and the mean logarithmic energy decrement  $\xi$ , as a function of neutron energy. The temperature of the moderator was taken as  $300^\circ\text{K}$ . On the Debye model it is very difficult to take account of processes in which more than 2 phonons are involved and as these higher order processes become important for neutron energy greater than about  $k\theta_D$ , in this high energy region we have used the Einstein model of a solid (Einstein temperature  $\theta_E = 740^\circ\text{K}$ ) to calculate the scattering cross-sections and  $\xi$ . The two curves for  $\xi$  have been smoothly joined and values given by this curve have been used for further calculations.  $\xi$  goes to zero at  $E = 600\text{ k}$ . Below this energy it is negative and tends to  $-\infty$  as  $E \rightarrow 0$ . For energies greater than  $600\text{ k}$ ,  $\xi$  increases and attains a constant value of  $0.2$  for  $E > 10,000\text{ k}$ . If we average this value of  $\xi$  over a Maxwell distribution we obtain a result which can be compared with experiment. The variation of the averaged  $\xi$  with the characteristic temperature  $T_0$  of the neutron distribution is shown in Fig. 1. As expected  $\bar{\xi}$  goes to zero at  $T_0 = 300^\circ\text{K}$ .

The neutron age can be calculated using the above value of  $\bar{\xi}$ . As in all idealised equilibrium

problems, the age tends to infinity as neutrons approach equilibrium. To determine the neutron age by this method it is essential to take into account the absorption of neutrons in the moderator, and this problem will not be considered here.

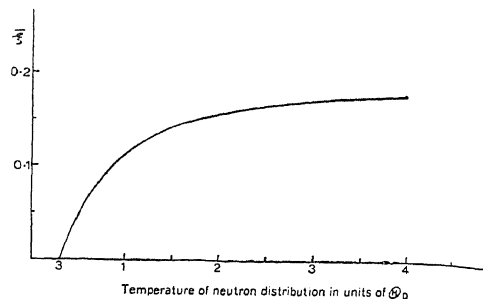


FIG. 1. Mean logarithmic energy decrement averaged over Maxwell distribution, as a function of characteristic temperature of the distribution.

An alternative method for studying the slowing down of neutrons is to calculate the mean energy loss per collision as a function of neutron energy. After suitably averaging this over the Maxwell distribution, the time variation of the temperature of the neutron distribution can readily be calculated and this is shown in Fig. 2. According to the calculations, the distribution approaches equilibrium at  $296^\circ\text{K}$  with a relaxation time of 19 microseconds.

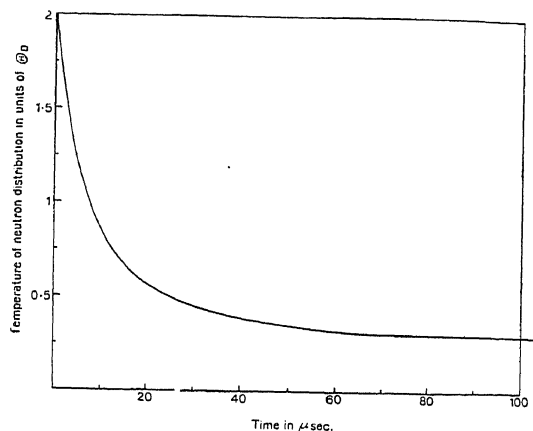


FIG. 2. Time variation of the temperature of neutron distribution.

For calculating the age we assume that the distribution is already in thermal equilibrium with the moderator when its temperature is  $300^\circ\text{K}$ . This gives an age from 1.44 eV. to thermal of  $20\text{ cm}^2$ . This has to be added to  $80.2\text{ cm}^2$  which corresponds to the age<sup>2</sup> from fission energy to 1.44 eV, giving a total age of  $100.2\text{ cm}^2$  from fission energy to thermal. This

may be compared with the total experimental age<sup>2</sup> of 97.2 cm.<sup>2</sup>

The slowing down time from fission to 1.44 ev. is 13  $\mu$  sec., whereas the time spent by the neutron in slowing down from 1.44 ev. to thermal is 100  $\mu$  sec., giving the total slowing down time of 113  $\mu$  sec.

It would be interesting to verify experimentally the calculated variation of neutron temperature with time.

Atomic Energy Establishment, K. S. SINGWI.  
Apollo Pier Road, L. S. KOTHARI.  
Bombay-1, July 26, 1956.

1. Kothari, L. S. and Singwi, K. S., *Proc. Roy. Soc., A*, 1955, **231**, 293.
2. Hughes, D. J., *Pile Neutron Research* (Addison-Wesley Pub. Co. Inc., Cambridge, Mass.), 1953, p. 125.

### AN EFFICIENT SOLUBILITY APPARATUS

THE solubility apparatus used by us and shown in Fig. 1 is essentially a modification of the

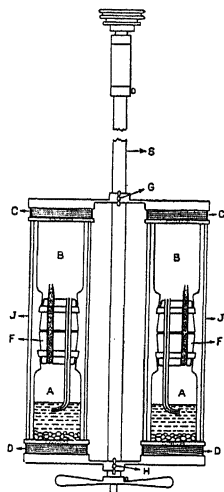


FIG. 1

one devised by Campbell.<sup>1</sup> Two wide-mouthed bottles A and B about 30 ml. capacity, are connected with each other by the filter gadget F. The filter device consists of two double-holed rubber bungs through which pass (1) a Pyrex tubing constricted at one end and plugged with glass-wool, and (2) a thick-walled 0.5 mm. glass capillary bent as shown in the figure. This arrangement is simpler, stronger and serves better than the glass-quill employed by Campbell. The bottles are held firmly by

cork rings inside the water-tight glass jacket J. The jacket consists of the 2 mm. thick Pyrex glass tube to the ends of which are fixed screwed brass rings C and D provided with caps. This glass jacket prevents direct contact between the solubility bottles and the liquid of the thermostat. A pair of jackets can be clamped in position between sockets to the vertical shaft S by means of screws G and H. During equilibration, the entire assembly rotates with the stirrer at desired speeds.

Bottle A is charged with the solvent and excess of solute and rotated until equilibrium is reached. The glass jacket is then inverted, it being held inside the bath all the time. The saturated solution filters through the tube containing glass-wool from A to B, the air being displaced simultaneously from B to A through the capillary. The filtration thus occurs continuously at exactly the same temperature as that at which the saturated solution is prepared. The bottles B and A containing the saturated solution and the wet residue respectively are then removed from the jacket, covered with ground glass plates and weighed for subsequent analysis.

The size of the bottles and the fittings could be altered according to the quantities involved. The apparatus has been found to work smoothly under various conditions and has been used in these laboratories since the last twenty years.

Dept. of General Chem., G. ARAVAMUDAN.  
Indian Inst. of Science, K. R. KRISHNASWAMI.  
Bangalore, July 31, 1956.

1. Campbell, A. N., *J. Chem. Soc.*, 1930, 179.

### PREPARATION OF CERIC ACETATE IN THE ANHYDROUS STATE AND ITS PHOTO AND THERMAL DECOMPOSITIONS

THE preparation of the cerous acetate in the anhydrous state has been reported.<sup>1</sup> Ceric acetate has not hitherto been isolated and is only known in solution.<sup>2</sup> We have separated ceric acetate in the anhydrous state by the reaction of cerous nitrate with a mixture of glacial acetic acid and acetic anhydride. The compound separated in well-defined crystals having garnet-red colour. The colour in the powder state is lemon-yellow. The compound is so prone to react with water that any trace of the latter would change the colour to white. Every precaution, therefore, had to be taken to

guard against moisture during its preparation, isolation and study of its reactions.

Cerium content of the compound was determined by ignition over a Teclu burner in tared platinum crucibles. The available combustion apparatus does not attain the decomposition temperature of the intermediate carbonate formed, thus preventing the direct estimation of carbon and hydrogen. Hence the alkali value, equivalent to the acetic acid formed by hydrolysis, was determined. The data recorded in Table I would show that the compound isolated is  $\text{Ce}(\text{CH}_3\text{COO})_4$ .

TABLE I

Weight of compound	Weight of oxide		Weight of compound	Req. vol. of NaOH soln. calculated	1-002 N/10 in c.c. found
	Calculated	Found			
0.1812	0.0829	0.0820	..	..	..
0.1686	0.0771	0.0756	0.1082	11.49	11.65
0.2442	0.1118	0.1124	0.1432	15.31	14.90
0.1818	0.0836	0.0844	..	..	..

The compound is sensitive to light. Exposure to sunlight with exclusion of moisture results in the reduction to cerous state. The mechanism of this photo-decomposition and the identification of the products are under investigation. The thermal decomposition proceeds in a manner whereby the ceric state is essentially maintained. The details of the two processes of decomposition will be published in due course.

Dept. of Chemistry,  
Ravenshaw College,  
Cuttack, July 30, 1956.

D. PATNAIK.  
S. PANDA.

1. Panda, S. and Patnaik, D., *J. Ind. Chem. Soc.* (to be published).
2. Newton Friend, J., *Text-Book of Inorganic Chemistry*, 2nd Edn., Charles Griffin Ltd., London, p. 403.

### CONVERSION OF HISTIDINE TO UROCANIC ACID IN GERMINATING SEEDS

In a previous communication<sup>1</sup> the conversion of histidine to glutamic acid or to an acid-labile derivative of glutamic acid in germinating greengram seeds (*Phaseolus radiatus*) was reported. The initial step in this conversion was shown to be the formation of urocanic acid by the deamination of histidine, in the case of animals<sup>2</sup> and bacteria.<sup>3</sup> Whether a similar conversion of histidine to urocanic acid takes place during the germination of greengram seeds has

been investigated through the isotope-trapping technique and the results are reported here.

10 g. of greengram seeds, divided into two equal lots, were allowed to germinate in 11 cm. petri dishes for 72 hours. The medium in each dish contained 6.16 mg. of 2- $\text{C}^{14}$ -labelled histidine with an activity equal to  $2.048 \times 10^7$  c.p.m. and also 30 mg. of inert urocanic acid in 24 ml. of sterile water. The urocanic acid added to the medium served to trap any radioactive urocanic acid that might be formed during germination. Germination and sterility tests were carried out as described earlier.<sup>4</sup>

At the end of germination, the seedlings were ground and thoroughly extracted with water. The extract was deproteinised by heat-coagulation at pH 5.0. An aliquot of the extract was reserved for the estimation of urocanic acid by its intense absorption at  $275 \text{ m}\mu$  and pH 7.0 in a Beckmann spectrophotometer.<sup>5</sup> To the remaining extract, 50 mg. urocanic acid was added as carrier and the solution concentrated *in vacuo*. The resulting brown syrupy solution was clarified by the addition of basic lead acetate solution, centrifuging off the precipitate and removing the excess lead with  $\text{H}_2\text{S}$ . The clear solution, on further concentration, pH adjustment to 4.6 and cooling yielded crude crystals of urocanic acid. The product was purified by several recrystallisations, until the fine needles obtained showed constant radioactivity. Activity measurements were carried out by the use of a flow gas counter as previously described.

TABLE I

Formation of urocanic acid from 2- $\text{C}^{14}$ -histidine

Amount of radioactivity in the histidine added	} $4.096 \times 10^7$ c.p.m.
Urocanic acid in the total extract	
Urocanic acid in the extract taken for isolation	} 75 mg.
Urocanic acid added as carrier	
Activity in sample (45 $\mu\text{g}$ ) of the urocanic acid isolated	} 60 mg.
Therefore, radioactivity in urocanic acid in the total extract	
Percentage of radioactivity in urocanic acid	} 50 mg.
	} 473 c.p.m.
	} $1.444 \times 10^6$ c.p.m.
	} 3.53

From the results presented in Table I, it will be seen that urocanic acid contains an appreciable amount of radioactivity. Thus there is a significant synthesis of urocanic acid from histidine during germination of greengram seeds. The rate of metabolism of neither histidine nor urocanic acid during germination is known. As such it is difficult to assess the exact quantitative significance of this conversion. However, the conversion of histidine to gluta-

mic acid, through urocanic acid as an intermediate, is concluded to be the main pathway of histidine degradation in animals and in *Pseudomonas fluorescens*.<sup>5</sup> This conclusion is supported by the presence of active histidase in these organisms. But all attempts at establishing the presence of histidase in 72 hr-old germinating greengram seedlings have been unsuccessful, though homogenates as well as clear supernatants were tested through a wide range of pH values.

University Biochem. V. M. SIVARAMAKRISHNAN.

Laboratory, P. S. SARMA.

Madras-25, August 4, 1956.

1. Sivaramakrishnan, V. M. and Sarma, P. S., *Curr. Sci.*, 1955, **24**, 330.
2. Mehler, A. H. and Tabor, H., *J. Biol. Chem.*, 1953, **201**, 775.
3. Tabor, H., Mehler, A. H., Hayaishi, O. and White, J., *Ibid.*, 1952, **196**, 121.
4. Sivaramakrishnan, V. M. and Sarma, P. S., *Biochem. J.*, 1956, **62**, 132.
5. Tabor, H., in *A Symposium on Amino Acid Metabolism*, 1955, Ed. McElroy and Glass, The John Hopkins Press, p. 373.

## OCCURRENCE OF HAEMAGGLUTININS IN CALF VACCINE LYMPH

VACCINIA HAEMAGGLUTININS have been studied in detail by many workers since Nagler<sup>1</sup> first described it of fowl red blood cells by material from vaccinal lesions on the chorioallantoic membrane of the egg. It is known that calf lymph conspicuously lacks this property. While Nagler<sup>1</sup> states that hæmagglutinins are absent from calf lymph, others<sup>2,3</sup> have suggested the possibility of their being present in a masked form. Evidence is presented in this paper that hæmagglutinins are produced in calf lymphs but masked by certain inhibitors. In the case of buffalo calf lymph, the inhibitor seems to be of the nature of an antibody. In the case of cow calf lymph, however, there seems to be some other inhibitors as well.

A large number of samples of buffalo calf lymph (fresh and old) were subjected to hæmagglutinin tests. While none of the fresh ones agglutinated the fowl blood cells, older samples (a year or more old) gave positive hæmagglutination reaction—the degree of reaction being proportional to the age of the calf lymph with maximal titration in 4 years or more old lymphs. This hæmagglutination was found to be specific as it could be neutralised only by its immune serum.

Fresh buffalo calf lymph possessing no hæmagglutinating property gave positive

hæmagglutination reaction when subjected to heat at 80° C. for half an hour, indicating the presence of both the hæmagglutinins and heat sensitive inhibitors. Temperatures below 80° C. did not inactivate the inhibitor. Precipitation with ammonium sulphate (50% saturation) carried the inhibitor along with the precipitate and that too with the water-soluble portion. It is known that the antibodies against vaccinia hæmagglutinins in immune sera possess the same properties.<sup>3</sup>

Material from one- and two-day-old vaccinal lesions from buffalo calves show evidence of hæmagglutination, but the one from lesions older than two days did not agglutinate the fowl red blood cells without pretreatment with heat. The examination of sera from these calves, 6 hours, 24 hours, 2 days, 3 days, 4 days, 12 days and 15 days after vaccinia infection showed development of anti-hæmagglutinins in the blood 2 days after vaccination, synchronising with the non-hæmagglutination of fowl cells by material from vaccinal lesions older than 2 days. Gradual increase in titre was noted till the 12th day. It is clear from this that vaccinal lesions on the buffalo calf fail to agglutinate the fowl red blood cells only after the appearance of the anti-hæmagglutinins in the blood. Since chick embryos do not produce antibodies,<sup>4</sup> it is not surprising that the vaccinal lesions on chorioallantoic membrane of eggs do agglutinate the fowl red blood cells readily as there is no interfering antibody.

In the case of cow calf lymph, however, it was observed that the lymph at 80° C. for half an hour did not release the hæmagglutinins. It required boiling for 1 minute to observe the hæmagglutination phenomenon. Further, while old buffalo calf lymphs gave positive hæmagglutination reaction, old cow calf lymph (oldest was six years old) gave no evidence of hæmagglutination. Again precipitation with ammonium sulphate (50% saturation) did not completely remove the inhibitors. The nature of these inhibitors is being studied in detail.

The author is indebted to Dr. S. Seshagiri Rau, Director of Public Health, in Mysore, Bangalore, for his valuable support and advice during the study.

Vaccine Institute, V. N. KRISHNAMURTHY.  
Bangalore-2, May 9, 1956.

1. Nagler, F. P. O., *Aust. J. Med.*, 1942, **1**, 281.
2. Stone, J. D. and Burnet, F. M., *Aust. J. Exp. Biol. Med. Sci.*, 1946, **24**, 9.
3. Chu, C. M., *J. Hyg. Camb.*, 1948, **46**, 49.
4. Burnet, F. M., Stone, J. D. and Edney, M., *Aust. J. Exp. Biol. Med. Sci.*, 1950, **28**, 29.

## SICKLE-CELL TRAIT IN SOME TRIBES OF WESTERN INDIA

SICKLE-CELL trait or sicklæmia has been reported in Negroes in many parts of Africa and America. Recently this trait has been found to be present among the white people of the Mediterranean region (Greece, Italy, Sicily, Egypt and Turkey). In India, Lehmann and Cutbush<sup>1</sup> found sickle-cell trait among the aboriginal tribes of Nilgiri Hills. Büchi<sup>2</sup> has repeated this study and confirmed the finding. Dunlop and Mozumdar<sup>3</sup> reported cases of sickle-cell trait and some presumptive cases of sickle-cell anæmia among the tea garden labourers of Upper Assam, originating from the tribal populations of Orissa and Bihar. Foy *et al.*<sup>4</sup> examined 5,000 samples in Eastern and Southern India and have reported a large percentage of sickle-cell trait in some of the tribes examined by them in both these regions. They have not reported their findings in detail so far. Bhatia *et al.*<sup>5</sup> reported four cases of sickle-cell trait in a family of nine members of Danukh caste in Mainpuri District of Uttar Pradesh.

The purpose of the present communication is to report the incidence of sickle-cell trait among some tribes and castes of Western India. The tribal groups included Bhil, Dhodia, Dubla, Koli and Naika, selected by virtue of being the most numerous groups in Gujarat. Castes included Anavil Brahmins, Leva Patidars, Marathas and a mixed group consisting of Mohammadans, Parsis, Gujaratis and Maharashtrians. Care was taken to include, as far as possible, only unrelated individuals in this study.

Bhils were investigated from Mirakhedi and Limkheda villages near Dohad in the Panch Mahal district. The other four tribal groups were studied from the Surat District. Dhodias were taken from Puna village in Mahuva taluka; Dublas, from Varad village of Bardoli taluka and Hansapore village of Navsari taluka; Kolis also from Hansapore village and Naikas, from Mandir village of Navsari taluka and Lavacha village of Pardi taluka. Anavil Brahmins were collected from Navsari taluka of Surat District and Leva Patidars of Charotar were collected from Nadiad of Kheda District. Marathas and the mixed group, from Bombay, also were included in this study.

Sickling test on the red cells was done on the spot using freshly prepared 2% sodium metabisulphite as described by Daland and Castle.<sup>6</sup> Care was taken to read the results within half-an-hour to avoid false positive reactions. The samples were preserved in ice and were again tested in the laboratory.

As an independent check, some of the samples were run by paper electrophoresis using horizontal pattern apparatus described by Smith and Conley.<sup>7</sup> Hæmolysates were prepared from saline washed red cells, freed of cell stroma and diluted to 6-8 g.%. Filter-paper (Whatman 3 MM) strips, 5 cm. × 38 cm., were soaked in Veronal buffer pH 8.6 with an ionic strength of 0.05 and blotted dry. A streak of hæmolysate was applied to the strip of paper which was supported between siliconized glass plates. Electrophoretic runs were made at 20-22° C., 200-220 volts, 3-5 ma, for 10-12 hours. Two known samples, one containing a mixture of hæmoglobin A (normal adult) and S (sickle-cell) from a case of sickle-cell trait and the other only hæmoglobin A (Lehmann and Sukumaran<sup>8</sup>) were used as controls in every run.

The results of the sickling test are given in Table I.

TABLE I

Caste or tribe	No. of persons tested	No. of persons with sickling	Percentage incidence
Bhils	206	32	15.53
Dhodias	107	22	20.58
Dublas (Talavia)	211	20	9.48
Kolis	51	0	0.0
Naikas or Naikadas	90	20	22.22
Anavil Brahmins	53	0	0.0
Leva Patidars	150	0	0.0
Marathas	201	0	0.0
Mixed group	222	0	0.0

Out of 94 samples that showed sickling, 78 were suitable for electrophoresis. All these samples showed mobilities similar to the mixture of hæmoglobin A and S used as control thus confirming the presence of sickle-cell hæmoglobin in the heterozygous form. 191 samples of Dublas that did not show sickling were also run for electrophoresis. All showed a pattern similar to hæmoglobin A, ruling out the presence of any other abnormal hæmoglobin in this sample.

The results thus showed a remarkable variation in the incidence of sickle-cell trait among these tribal groups varying from practically no incidence among Kolis to more than 20% among Dhodias and Naikas. There was a low incidence of  $R_0$  (cDe) chromosome among these tribes. The only other study in India, reported in detail so far, is from Nilgiris where incidence of sickle-cell trait ranged from 4% to as high as 34%, with a low incidence of  $R_0$

chromosome. It is hoped that the present finding will be of anthropological and medical interest.

The authors are grateful to Dr. V. R. Khanolkar, Director, Indian Cancer Research Centre, for his encouragement during the course of this study. They are thankful to Dr. N. M. Purandare, Professor of Pathology and Bacteriology, Seth G. S. Medical College, for his interest in this investigation. Thanks are also due to Shri P. G. Shah and Shri J. B. Naik of the Gujarat Research Society and Shri Sukhdeoobhai Trivedi and his associates of the Bhil Seva Mandal for their helpful co-operation in collecting the samples from the various tribes.

Human Variation Unit, P. K. SUKUMARAN.  
Indian Cancer Res. Centre, L. D. SANGHVI.  
and  
Dept. of Pathology and G. N. VYAS.  
Bacteriology,  
Seth G. S. Medical College,  
Bombay-12, July 24, 1956.

1. Lehmann, H. and Cutbush, M., *Brit. Med. J.*, 1952, i, 404.
2. Büchi, E. C., *Anthropologist*, 1955, 1, 25.
3. Dunlop, K. J. and Mozumdar, U. K., *Ind. Med. Gaz.*, 1952, 87, 387.
4. Foy, H., Brass, W. and Kondi Athena, *Brit. Med. J.*, 1956, i, 289.
5. Bhatia, H. M., Thin, J., Debray, H. and Cabanes, J., *Bull. de la Societe d'Anthropologie*, 1955, 6, 199.
6. Daland, G. A. and Castle, W. B., *J. Lab. Clin. Med.*, 1948, 33, 1082.
7. Smith, E. W. and Conley, C. L., *Bull. Johns Hopkins Hospital*, 1953, 93, 94.
8. Lehmann, H. and Sukumaran, P. K., *Man*, 1956, 56, 95.

#### ANATOMICAL DEFECTS OF THE REPRODUCTIVE ORGANS IN CATTLE FOUND IN UTTAR PRADESH

ACCORDING to Williams<sup>1</sup> the reproductive system of most monsters are conspicuously abnormal, but fortunately in these cases the basic monstrosity excludes possibility of reproduction. Genital aberrations, in otherwise normal animals, are of great economic importance. Earlier diagnosis by breeders and veterinarians would considerably reduce the expenses in the maintenance and feeding of these animals. The still greater importance of these defects lies in the fact that most of them are hereditary.<sup>1-4,6</sup> In a country like ours where we do not like to kill cows or her progeny, it is still

more important that we do not breed and increase undesirable and defective progeny. With this objective in view, while conducting palpation of the genital organs per rectum or carrying out clinical examination of the genitalia in bulls used at Artificial Insemination Centres, the following observations were made:

(a) *Cryptorchid*.—The testicles of domestic herbivora migrate from the abdomen into the inguinal canal before birth. Williams<sup>1,5</sup> found this condition most common in horses and swine. He also observed 75% of cryptorchid in the progeny of a monorchid ram. According to him it is definitely hereditary, and he attributes it to a genetic defect in the spermatozoa or ova, and not to some developmental disturbance in intra-uterine life. A Haryana calf with one testicle was seen at a bull rearing farm in Mathura District. In Sahiwal breed, a similar case was observed in another farm in Barabanki District. It was a farm-bred bull. On clinical examination, the left testicle, the cauda, caput and corpus epididymis appeared to be normal. On the right side, a small testicular bulb, the size being approximately 2" x 1", appeared to be present near the inguinal canal. The size of the seminal visicle on both sides was found normal.

Eriksson<sup>6</sup> found that the sexual gland hypoplasia seen in cattle in Sweden is hereditary and is due to an autosomal recessive gene with incomplete penetration.

(b) *Anatomical Deviation in the Position of the Two Testicles*.—In a buffalo-bull, stationed at an artificial insemination centre in Partabgarh District, it was found that the two testicles were not present on the sides but one was anterior to the other as is normally seen in the canine species. The bull is otherwise very active, has a good sex-libido and gives good quality semen.

The male calves born from this bull have the same appearance. The scrotum is notched in the middle and is not circular (bag-like). Upto March 1955, 486 inseminations have been made out of which 310 pregnancies have taken place. The abnormality has been observed in about a dozen male calves. There might be many more in the different villages and as the calves are still young, the owners may not have observed it. In the female calves, examination per rectum is not possible at this stage but it may be that corresponding anatomical abnormality may also be present in them too.

The above observations indicate that at least in males the condition is hereditary.



(c) *Underdevelopment of the Genitalia in a Hariana Heifer*.—A Hariana heifer, aged 3½ years, said to have never come to oestrus in quite good health, was seen at Hapur Gaushala. The vulva and vagina were very small. The heifer speculum (Russian model) could not be introduced as the vagina was too small. Examination per rectum showed a small corpus uteri, unrecognisable cervix. The ovaries could not be palpated.

The udder was very small with very little glandular tissue and with rudimentary teats. The heifer was born as a twin-mate to a male calf. As cases of 'Free martin' are quite common in cattle this might be one of such cases in which the female sex organs have not developed owing to the male sex-hormones circulating in the blood during intra-uterine development. This would be permanently sterile.

This case of 'free martin' is being recorded for the first time in India.

(d) *Non-Development of Mullerian Ducts in Sahiwal*.—A farm-bred heifer, aged 5½ years, in good health and body development was examined. The vulva and vagina were well developed and were like as in multipara. On examination per rectum the cervix, corpus uteri could be detected with great difficulty. The horns were very thin. The tubal area of the genital organ develops from the Mullerian ducts in the female and evidently it appears that this has not developed in this case.

The udder had 5 teats out of which one was well developed and surprisingly yielded milk. The other four were very small.

The malformations of the genital organs of a minor nature are sometimes seen during general clinical examination. They may or may not affect fertility but are definitely not normal structures. In the West, where big slaughter-houses exist, extensive anatomo-pathological studies can be made while, in our country, we have to depend on clinical findings and, therefore, our data would always indicate a much lower incidence of such malformations.

Cryptorchid; anatomical deviation of the testicle in the buffalo-bull; monsters; genital defects in the female are regarded by many as isolated, meaningless curiosities but many such anatomo-physiological defects are hereditary. Teratological defects not only constitute an inferiority in the individual, but are transmitted to the progeny. To avoid such defects,

breeding animals should therefore be carefully selected.

MAHENDRA PRATAP JOHARI.

Regional Sterility Centre,  
U.P. College of Veterinary

Science and Animal Husbandry,  
Mathura, January 30, 1956.

1. Williams, W. L., *Diseases of the Genital Organs of Domestic Animals*, Ithaca, New York (U.S.A.), 1943.
2. —, *Cornell Veterinarian*, 1936, **26**, 1.
3. —, *Ibid.*, 1931, **21**, 25.
4. McPhee, Russell and Zeller, *J. Heredity*, 1931, **22**, 295.
5. Warwick, B. L., *Ohio Agr. Expt. Station, Bull.*, 480, 1931, Citation from Williams, Ref. 1.
6. Eriksson, K., *Hereditary Form of Sterility in Cattle*, Lund, 1943.
7. Gilmore, O. Lester, *J. Dairy Science*, 1949, **32**, 71.

#### CONDITION FACTOR IN SOME FISHES OF LUCKNOW, UTTAR PRADESH

The relation of the length and weight in fishes follows approximately the cube law relationship expressed by the formula  $K = 10^5 W/L^3$ , in which  $W$  is the weight in grammes,  $L$  the length in millimetres and  $K$  a constant. This constant  $K$  fluctuates and Heincke<sup>1</sup> proposed the use of the factor as the index of the well-being of the fish. This factor is often referred to as the "Condition factor" or the "Coefficient of condition", and is used to indicate suitability of an environment or to compare fish from one lake or area with a general average for an entire region. Khan and Hussain,<sup>2</sup> and Jhingran<sup>3</sup> have made observations on the weight-length relationship in some fresh-water fishes but condition factor studies do not appear to have been pursued so far in India.

The data are derived from 850 specimens of four different species of adult fishes, viz., *Cirrhina reba* (Ham.), *Amblypharyngodon mola* (Ham.), *Rohtee cotio* (Ham.), and *Oxygaster bacaila* (Ham.), obtained from the La Martiniere Lake, Lucknow, during 1954 to 1955. The fishes were preserved in 5% to 8% formalin and at a later date measured as to total length to the nearest millimetre and weighed to the nearest centigram. Preservation in formalin, however, raises the condition factor by increasing the weight and decreasing the length of the fish. No attempt has been made to adjust the factors for this increase since the same order of change prevails in both fresh and preserved fish as observed by Hoar.<sup>4</sup>

Average values of the condition factor of the four species of fish were calculated for the

different months during 1954-55. Four definite periods were recognised in the values of the condition factor of these fishes as seen in Fig. 1, the values being highest during winter (January, February and March), and

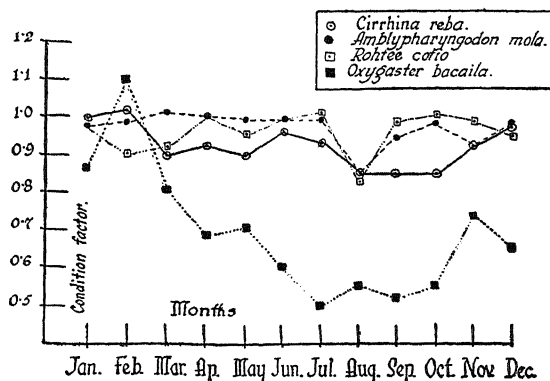


FIG. 1. Variations in the condition factor of *Cirrhina reba*, *Amblypharyngodon mola*, *Rohitee cotio* and *Oxygaster bacaila*, in the different months during 1954-55.

slightly lower in the pre-monsoon period (April, May and June). During the pre-monsoon period the adult fishes are generally sexually mature, hence an increase in the condition factor. Differences in the variations in the environmental conditions as observed by Das and Moitra<sup>5</sup> also influence increase in the weight of the fish. In the monsoon period (July, August and September) most of the fishes spawn and become spent thus recording a decline in the condition factor. In the post-monsoon period (October, November and December) the fishes gradually improve in condition. The extent of this rise and its duration depends on the local feeding conditions. *Cirrhina reba*, a herbivorous fish, has the slowest recovery. *Amblypharyngodon mola* shows sharper recovery although it is a herbivorous fish, while *Rohitee cotio* and *Oxygaster bacaila*, both omnivorous fishes, record steep rise in the condition factor. In similar studies by Menzies<sup>6</sup> for the salmon of Scotland, there is in general a sharp spring improvement followed by a falling in condition during late summer and autumn. He concludes that the rise is due partly to an increase in the size of the fish and partly to seasonal improvement. These differences are not only related to differences in spawning periods of the fishes, but also to differences in available food and environment.

The author wishes to acknowledge his gratitude to Dr. S. M. Das for his guidance and constant encouragement during the course of

the work and to the Scientific Research Committee, U.P., for a research grant.

Dept. of Zoology, S. K. MOITRA,  
The University, Lucknow,  
May 15, 1956.

1. Heincke, F., *Die Beiteilung Deutschlands a. d. internat. Meeresforschung*, Jahresber, 1908, **74-5**, 67.
2. Khan, H. and Hussain, A., *Proc. Ind. Acad. Sci.*, 1944, **20 B**, 224.
3. Jhingran, V. G., *Proc. Nat. Inst. Sci.*, 1952, **18**, 449.
4. Hoar, W. S., *J. Fish. Res. Bd. Canada*, 1939, **4**, 441.
5. Das, S. M. and Moitra, S. K., *Curr. Sci.*, 1955, **24**, 417.
6. Menzies, W. J. M., *Fish Scotland Salmon Fish*, 1921, **2**, 1.

#### A FERMENTATION PROCESS FOR THE PRODUCTION OF QUALITY FISH MEAL

MATHEW, NAIR AND RAMAKRISHNAN<sup>1</sup> observed that the fishy odour of shark liver oil is completely removed as a result of agitation of the oil with fermenting milk for 36 hours. This suggested the possibility of preventing the development of rancidity in fish meals by the treatment of the raw material with fermenting milk.

A number of experiments were conducted in which minced flesh from different fishes was treated separately with small quantities of buttermilk (after defatting) and the final products examined for their keeping qualities. Surprisingly enough, the analyses of the different samples of the fish meals showed that under certain conditions the oil content of the fish is considerably reduced in the final product, and that the meals did not develop the characteristic rancid odour of the untreated fish powder even after keeping in glass bottles for over 9 to 10 months. The details of the process are as follows:

The fish after removal of viscera and scales is minced well in a meat mincer. The required quantity of defatted buttermilk (about 1 oz. to 6 lb. of minced flesh) is added and the whole material is mixed thoroughly with the minimum quantity of water. The pH is maintained between 4.5 and 5.0 and the temperature is raised to about 30-35° C. by keeping the container in the sun or in lukewarm water. The reaction is allowed to continue for about 4 hours with constant stirring. The material is pressed afterwards in cloth bags and dried in the sun.

The final product is found to have a better appearance than the simple sun-dried and pow-

dered sample and is as good as the products obtained from the wet reduction process.

For detailed study and comparison, meals were prepared by the following three different methods: (1) simple sun-drying and powdering, (2) cooking, pressing, drying and powdering, and (3) fermenting, pressing, drying and powdering. Five different species of fish have been tried, viz., *Sardinella albella*, *Sardinella gibbosa*, *Ilisha brachysoma*, Rays and shark (*Carcharinus* sp.). Samples of fish meal obtained from these species were analysed for their moisture, fat, total and water-soluble protein contents. The results are presented in Table I.

TABLE I  
Analysis of fish meal

Name of fish from which meal is prepared	Moisture %	Fat %	Total-N %	Protein (N x 6.25) %	Water-soluble protein % of total-N
<i>Sardinella albella</i> a	6.1	9.8	..	..	..
do .. b	7.0	3.7	13.30	83.13	5.0
do .. c	6.4	4.1	14.35	89.68	15.6
do .. d	8.3	1.4	..	..	..
<i>Sardinella gibbosa</i> a	6.4	10.1	11.90	78.38	17.6
do .. b	9.8	6.0	13.50	84.38	6.2
do .. c	5.8	6.2	14.00	87.50	10.0
<i>Ilisha brachysoma</i> a	7.2	7.1	..	..	..
do .. b	6.8	4.1	12.95	80.94	6.0
do .. c	9.0	3.4	13.30	83.13	10.5
Shark .. a	7.2	1.8	14.00	87.50	18.5
do .. b	5.3	0.8	14.94	93.38	6.8
do .. c	5.8	0.6	15.08	94.25	18.2
do .. b	8.4	0.6	14.78	92.38	5.9
do .. c	9.2	0.3	14.50	90.63	14.2
Ray .. a	9.2	3.2	..	..	..
do .. b	9.9	1.3	14.35	89.68	9.8
do .. c	7.6	2.2	14.35	89.68	16.1

\* a—Simple sun-dried and powdered; b—Cooked, pressed, dried and powdered; c—Fermented, pressed, dried and powdered, d—Solvent extracted, dried and powdered.

It may be seen from the table that in samples obtained by the fermentation method there is a considerable reduction in the oil content, both in the oily varieties such as *Sardinella albella* and *Sardinella gibbosa* and the non-oily fishes like sharks and rays. The rate of reduction of fat is quite comparable to that obtained in the cooking process although it is not found as efficient as solvent extraction. From the values for the protein contents of the fish meals it must be presumed that the treatment does not materially affect the amount of protein. It is quite likely that in the fermentation process the bacterial action induces some sort of zymolysis of the fat component of the fish flesh

and it is disrupted and simplified without impairing the proteins.

The water-soluble protein contents of the fermented samples also provide some interesting results. The percentage of this component in the product obtained from the fermentation process is seen to be nearly equal to that found in the simple sun-dried product. As against this, in the product prepared by the conventional method of cooking the major portion of water-soluble proteins is removed.

The above preliminary observations indicate that the fermentation process may be adopted to advantage for the preparation of good quality fish meal from both fatty and lean fishes. The appearance and the quality of the product obtained from shark and other cheap fish flesh also suggest the possibility of preparation of odourless 'Fish Flour' from these varieties by this method. The method has many advantages over the traditional methods in that elaborate cooking arrangements and the use of costly solvents are avoided, ensuring at the same time a good quality fish meal. But since the fat in the fish is believed to be disrupted as a result of the reaction it may be best suited in cases where the recovery of oil from the flesh is uneconomic.

My grateful thanks are due to Dr. N. K. Panikkar for guidance and encouragement.

Central Marine V. KRISHNA PILLAI.

Fisheries Research Station,  
Mandapam Camp, August 6, 1956.

I. Mathew, P. K., Nair, P. V. and Ramakrishnan, T. A., *Proc. Ind. Sci. Cong.*, 1949, Part III, Abst., 101.

#### *PSEUDOMONAS TUTICORINENSIS* N. SP., A MARINE DENITRIFYING BACTERIUM\*

The occurrence of a large number of denitrifying bacteria from sea-water and other marine materials in India has been recorded,<sup>1-4</sup> and the activities of some of them described.<sup>2</sup> It has been pointed out that these bacteria may symbiotically and in other ways reduce nitrates to nitrites and gaseous nitrogen and thus cause loss of nitrogen from the seas. The low nitrate content in restricted areas of our sea-waters and their fluctuation are attributed to the number and activity of denitrifiers.<sup>5</sup>

During a study of the bacterial groups in marine environment, a culture was obtained from marine sand, off Tuticorin, inoculated into

\* Published with the kind permission of Director of Industries and Commerce (Fisheries), Madras.

cellulose enrichment medium, which produced gas from nitrate. A description of this culture is given below.

**Morphology.**—Rods, straight, actively motile with a single polar flagellum,  $0.4 \mu \times 0.6 \mu$ , single and in pairs, gram negative, non-spore-forming. **Cultural Characteristics:** Sea-water—Agar colonies—white, opaque, smooth, circular, entire, raised, with translucent periphery; Agar stroke—abundant, white butyrous, glistening turning cream-coloured with age. **Biochemical Properties:** Very heavy turbidity and abundant slimy sediment in broth; acid from glucose, sucrose, galactose, xylose and arabinose; does not ferment lactose, mannitol and glycerol. Brom-cresol-purple milk unchanged but with 3% NaCl a soft coagulum was produced and turned alkaline; gelatin not liquefied; indole and  $H_2S$  (peptone iron agar) not produced; starch partially hydrolysed; nitrate in broth reduced to nitrites and to gaseous nitrogen; (0.5%  $KNO_3$  completely reduced in 6 days); denitrification also with lactate as hydrogen donor; grows in the presence of 0.005% hyd xylamine but not in 0.025%, without production of gas; grows and proliferates with only 200 p.p.m. organic matter (peptone) but requires 1,500 p.p.m. for denitrification. No growth in fresh-water media; no fluorescent pigment produced; aerobic; facultative. Good growth at  $37^\circ C$ . Note: All media were made up with 'aged' sea-water.

This culture differs from any that have been described in literature,<sup>6,7</sup> and reviewed by us elsewhere.<sup>2</sup> It is therefore considered a new species of marine pseudomonas and is named *Pseudomonas tuticorinensis* N. sp. The culture is in deposit in American Type Culture Collection (ATCC 12230) and in N.C.T.C., Poona.

Fisheries Technological Station, A. SREENIVASAN.

Station, R. VENKATARAMAN.

Kozhikode-1, June 16, 1956.

## OCCURRENCE OF NODAL GALLS ON SUGARCANE

THE occurrence of 'Galls' on cultivated sugarcane was first reported from Hawaii.<sup>1</sup> Pemberton<sup>2</sup> investigated the possible relationship of the attack of the stalk mite *Tarsonemus spinipes* Hirst with the formation of nodal galls. Martin (quoted by Wismer<sup>3</sup>) observed that stem galls could develop on healthy plants of certain varieties of sugarcane when inoculated with insect extracts. In India, Narasimha Rao<sup>4</sup> has found occurrence of malformations at the growing point in *Saccharum spontaneum* L. caused probably by a dipteran fly.

During the course of observations on a sugarcane ratoon varietal test at the Government Agricultural Research Station, Rudrur, Hyderabad State, the authors noticed galls in three of the four varieties under test. The percentage of affected stalks as calculated on the basis of observations on 50 stalks taken at random for each variety were approximately: Co. 471—22%, Co. 475—19.5%, Co. 522—6.5%, Co. 624—0.0%. The gall formation occurred in the month of October when the crop was ten months old. The galls are irregular in shape and mostly found in the upper half of the stalk in the root band region. Invariably, the growing point of the affected cane is killed and the stalk remains stunted. The galls when kept in cultures, yielded a species of microlepidopterous moth (*Eucosmidæ*?) which is still under identification. The caterpillars which are delicate and pale white in colour bore into the nodal region of a cane to form galls each containing 20-25 of them. While rearing in the culture, most of the caterpillars come out of the galls. Pupation takes place in the galls only.

Further observations showed that planted crop of variety Co. 744 was affected during the months of September-October 1955 while the other varieties in the test were free from galls.

This is presumably the first record of insect galls on a cultivated variety of sugarcane in India.

Our sincere thanks are due to Sri. K. L. Khanna for encouragement.

Govt. Agri. Res. Station, M. Q. KHAN.  
Rudrur, D. V. MURTHY.  
Nizamabad Dist., S. K. SASTRY.  
Hyderabad-Deccan, June 14, 1956.

1. Venkataraman, R. and Sreenivasan, A., *Proc. Ind. Acad. Sci.*, 1954, **40**, 161 and unpublished data.
2. Sreenivasan, A. and Venkataraman, R., *J. Gen. Microbiol.*, 1956, **15** (2) (in press).
3. Sreenivasan, A., *Curr. Sci.*, 1956, **25**, 92.
4. Velankar, N. K., *Ind. J. Fish.*, 1955, **2**, 96.
5. Jayaraman, R., *Ibid.*, 1954, **1**, 345.
6. ZoBell, C. E. and Upham, H. C., *Bull. Scripps. Inst. Oceanogr.*, 1944, **5**, 239.
7. Bergey's *Manual of Determinative Bacteriology*, 6th Ed., 1948. Williams and Wilkins, Baltimore, U.S.A.

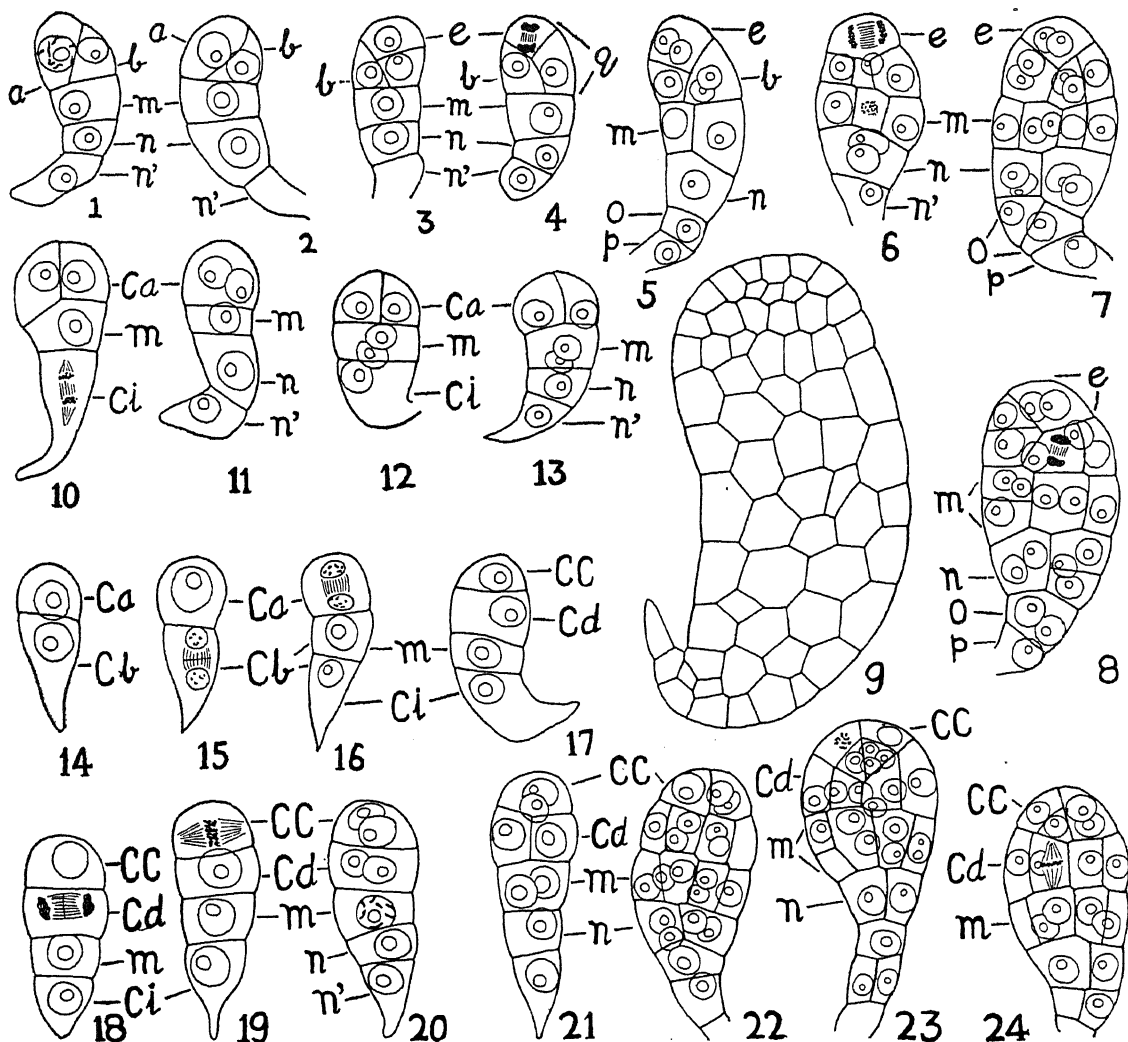
1. Lyon, H. L., *Hawaiian Plant Record*, 1926, **30**, 492.
2. Pemberton, C. E., *Ibid.*, 1929, **33**, 152.
3. Wismer, C. A., *Proc. 8th Cong. Int. Soc. Sugar cane Tec.*, Barbados, West Indies, 1953, 945.
4. Narasimha Rao, G., *Curr. Sci.*, 1954, **23**, 1, 29.

# VARIATIONS IN THE DEVELOPMENT OF PROEMBRYO IN *UTRICULARIA* *COERULEA* L.

IN recent years sufficient literature has accumulated regarding embryo development in the Lentibulariaceae. Crété,<sup>1</sup> in his recent paper, has briefly reviewed the earlier work on the embryogeny of this family. Johansen<sup>2</sup> has recorded that the development of embryo in the Lentibulariaceae corresponds to the Polemonium variation of the type Chenopodiad. Reayat Khan,<sup>3</sup> working on *Utricularia flexuosa*, has concluded that the development of embryo

conforms to *Catalapa* variation of the Onagrad type. Besides this, he has figured several variations in the development of the embryo. Crété<sup>1</sup> has come to the conclusion that the embryo development of *Pinguicula leptoceras* is of the sub-arche type of the *Capsella*. While the development of the embryo in *Pinguicula* appears to be of a definite type, it is not certain in *Utricularia*.

In *Utricularia coerulea* the early development of embryo shows some variations. Broadly, at the tetrad stage, the proembryo can be classified into three types: (i) the tetrad of the



FIGS. 1—24. Some stages in the development of embryo. (*ca*, apical cell and *cb*, basal cell of the two-celled embryo; *cc*, upper daughter cell and *cd*, lower daughter cell of the apical cell in the tetrads of  $C_2$  series *a* and *b*, daughter cells of the apical cell, cut off by an oblique wall in the tetrad of  $B_2$  series; *m*, intermediate cell of the tetrad; *ci*, lower cell of the tetrad; *n* and *n'*, daughter cells of *ci*; *o* and *p*, daughter cells of *n'*; *e*, epiphysis cell and epiphyseal tissue; *g*, quadrant). All Figs.,  $\times 485$ , except Fig. 9,  $\times 243$ .

series  $A_2$  (Fig. 10), (ii) the tetrad of the  $B_2$  series where the apical cell *ca* has an oblique vertical wall (Fig. 1), and (iii) a linear tetrad of the  $C_2$  series (Figs. 16, 17).

Thus in the same species, *Utricularia caerulea*, there are three types of proembryonal tetrads. In the tetrad of  $B_2$  series a definite epiphysis is organised (Figs. 2-8). But, it is difficult to specify what are the essential stages of development starting from these various fundamental forms. The Figs. 10-13 correspond to the tetrad of  $A_2$  series. Besides these, there are more stages of embryo development evidently derived from tetrads of  $B_2$  series (Figs. 1-8) and series  $C_2$  (Figs. 14-24). In these two cases, the apical cell *ca*, like in a normally constituted embryo, might give rise on one hand to initials of the stem surface and on the other the cotyledons *sensu stricto* (but the cotyledons reduced). But, the major portion of the hypocotyl would come from some intermediate cell of the tetrad. However, further stages of differentiation were obscure. The mature embryo appears to be an undifferentiated mass whose cells are smaller at the apex and larger towards the base (Fig. 9). Even the differentiation of root cap could not be made out (Fig. 9).

Such variations in the development and organisation of embryo are not uncommon. Crété<sup>1</sup> has stated that the embryogenesis of the Lentibulariaceae is consistent with the sub-archetype of the *Capsella*. However, in the development of the embryo of *Pinguicula leptoceras*, he has observed some variations or anomalies like, in the organisation of quadrants, oblique partitioning during dermatogen differentiation, etc. But, there are some late variations which do not modify the fundamental laws of embryogeny, while in *Utricularia caerulea* they are precociously seen in the second generation, and serve to connect the several types which differ radically from one another.

It must be concluded that in the Lentibulariaceae, *Pinguicula* presents tetrads according to  $A_2$  series and that the development of the embryo is connected, undoubtedly, to the sub-archetype of *Capsella*. But, in *Utricularia* the development is very complicated. Souèges,<sup>4</sup> while dealing with the "Embryogenic system", classifies such forms which have anomalies under "Irregular types". According to him these irregular types form a category in which are arranged on the one hand, the embryonic forms which are developed according to the general rules but are variable with the individual plants that have been examined; on the other are the forms in which it is not possible to determine the regularity in the least. The

development of the embryo in *U. caerulea* follows the first category and shows variations. Of the three variations mentioned for *U. caerulea*, the  $A_2$  and  $C_2$  series are of frequent occurrence in the same species and in the same locule of the ovary. The exact causes for such variations in the same species are not known. But, Souèges<sup>4</sup> has attributed "Ancient hybridisation" as the cause for variations observed in embryogenesis.

Grateful acknowledgement is made to Prof. P. Crété, Faculté de Pharmacie, Université de Paris, France, for criticism and suggestions.

Dept. of Botany,

S. B. KAUSIK.

Central College,

M. V. S. RAJU.

Bangalore-1, July 30, 1957.

1. Crété, P., *C.R. Acad. Sci., Paris*, 1956, **242**, 1063.
2. Johansen, D.A., *Plant Embryology, Chronica Botanica*, 1950.
3. Reayat Khan, *Phytomorphology*, 1954, **4**, 80.
4. Souèges, R., "Embryogénie et classification." 3<sup>e</sup> fasc. (partie spéciale), *Première période de Systeme*, Paris, 1948.

#### A MALE STERILE MUTANT IN *N. TABACUM*

MALE sterility of species crosses of *Nicotiana* was reported in *debneyi-tabacum* and *megalsiphon-tabacum* crosses by Clayton<sup>1</sup> and in *Langsdorfii-Sandaræ* cross by Smith.<sup>2</sup>

Raeber and Bolton<sup>3</sup> reported a case of intra-variety male sterility occurring in populations of American Joiner, a flue-cured variety of *N. tabacum*, grown from aged seed at Kutsaga in 1953-54 and 1954-55 seasons. The proportion of male sterile to normal plants observed in the 1954-55 season was about one to twelve.

A similar male sterile plant was found at this Institute in 1952-53 in a 2 acre crop of Harrison Special, also a flue-cured variety of *N. tabacum*. It was slightly undersized and had smaller leaves. The floral branches of this plant were bare (Fig. 1) but for a few undersized capsules, flowers (Fig. 2) and buds. The ground below the plant was strewn with withered flowers complete with calyx and ovary. The corolla tubes were narrower and lobes smaller and less pink than normal. The style was about one-fourth inch longer than the stamens. The anthers were deformed and did not dehisce. Anther section showed a few pollen grains. The filaments were normal in this plant but in some of the male sterile  $F_2$  segregates (reported below) some of the stamens were replaced by petaloid structures (Fig. 3). This condition was observed in the

early flowers and was almost absent in the late ones. Fig. 2 shows the floral parts in



FIG. 1



FIG. 2



FIG. 3

detail. Pollen from dissected anthers could not fertilise either the flowers of the same plant or of other plants in hand pollinations. There was, however, no difficulty in setting when these abnormal flowers were used as females in crosses with other plants.

A small quantity of seed was available from the open pollinated capsules in 1952-53. Since the plant was in the centre of a two-acre crop of Harrison Special it was assumed that it resulted from the natural cross of the male sterile plant by pollen from normal plants of Harrison Special. A cross was also made with Golden Harvest, another flue-cured variety. Both the  $F_1$ s, each of 12 plants, raised in 1953-54 consisted only of plants normal in floral structure and fertility. Both segregated into male sterile and normal plants in the subsequent  $F_2$  generation in 1954-55. Five plants out of 59 in the progeny derived from open pollinated seed

and 5 out of 60 in that from the cross with Golden Harvest were male sterile. In the  $F_3$  generation (1955-56) the segregations were as given in Table I.

TABLE I  
Showing segregation in  $F_3$  families

Families derived from the open pollinated male sterile plant		Families derived from the cross with Golden Harvest	
Monogenic (3 : 1)		Monogenic (3 : 1)	
Normal : M.S.		Normal : M.S.	
11 : 3		50 : 11	
11 : 3		27 : 4	
11 : 5		26 : 6	
22 : 5			
Total ..	55 : 16	Total ..	103 : 21
Digenic (15 : 1)		Digenic (15 : 1)	
21 : 2		23 : 1	
55 : 5		11 : 1	
		34 : 1	
		13 : 2	
Total ..	76 : 7	Total ..	81 : 5
Apparently* non-segregating		Apparently* non-segregating	
7 : 0		22 : 0	
9 : 0		7 : 0	
19 : 0		13 : 0	
		10 : 0	
		12 : 0	
		34 : 0	
		35 : 0	
		34 : 0	
		33 : 0	
		67 : 0	

\* On account of the small numbers it is difficult to be sure that they breed true.

It will be seen from Table I that though the number of families as well as the number of plants in each family is small, segregations satisfying both monogenic as well as digenic ratios occurred in both the crosses. In the case of the natural cross, even the proportion of the two types of segregating and the true breeding families, which should theoretically be 4.8 monogenic : 1.8 digenic and 2.4 non-segregating, is fairly satisfactory. The cross with Golden Harvest, however, does not very well conform to expectation. Firstly, the normal plants in the monogenic segregation are in excess of the expected number in each of the families, and secondly, the proportion of the three types of families is very unsatisfactory. The causes for such performance remain to be investigated. However, the  $F_2$  segregations and the general behaviour of the  $F_3$  families would indicate that the male sterility described in this case is heritable and digenic.

The fact that flowers on the male sterile plants contained almost no viable pollen, made

it possible to utilise them in studying the amount of natural cross-pollination with fairly good precision. For this purpose, counts of flower scars and set capsules were taken on 14 plants in which the first flower opened from 30th January to 29th February. Both the counts were taken first on 20th March and secondly on 13th April. The percentage of natural cross-pollination was worked out by dividing the number of capsules set by the total number of flowers borne (number of scars plus number of capsules). The following indications emerge from the data:

The total number of flowers borne were 2,494 of which 183 set capsules. This would indicate natural cross-pollination having occurred at an average rate of 7.3% during the season. But, on the five plants which started flowering earlier, i.e., upto the middle of February, the amount of natural cross-pollination was less (5.5%) than on the late-flowering ones on which it was 8.9%. On the earlier flowering plants, the percentage rose from 3.7% to 13.8% later in the season while that on the late-flowering ones the corresponding rise was from 4.2% to 18.8%, as judged from the differences in counts on the two dates. The high increase late in the season is probably due to the fact that the flowers of the male sterile plant, being less showy, are able to attract more insects at that time, when the normal plants have almost finished flowering. The above data would indicate that the amount of cross-pollination during the main period of flowering is at least about 4%.

Central Tobacco                      N. R. BHAT.  
Res. Institute,                      T. KRISHNAMOORTHY.  
Rajahmundry, June 30, 1956.

1. Clayton, E. E., *J. Hered.*, 1950, **41**, 170.
2. Raebler, J. G. and Bolton, A., *Nature*, 1955, **176**, 314.
3. Smith, H. H., *Genetics*, 1951, **36**, 576.

#### A NEW BACTERIAL LEAF-SPOT ON *PHASEOLUS TRILOBUS*

LEAVES of *Phaseolus trilobus* Ait., the three-lobed kidney bean, were found to be affected by a bacterial leaf-spot at the Agricultural College Farm, Poona, in June 1954. The disease appears as minute water-soaked spots on the lower surface of leaves. With the progress of the disease, the spots enlarge in size, become angular and chocolate-brown in colour. In nature, only the leaves appear to be infected. The study of the various characters of the

pathogen indicates that even though it is closely allied to *Xanthomonas phaseoli* (Smith) Dowson, it differs from the latter in certain characters besides being highly host specific. It is, therefore, proposed to assign to it a new name, *Xanthomonas phaseoli-trilobi* sp. nov., whose technical description is as follows:

Short rods, single, rarely in chains,  $0.87 \times 1.44 \mu$ , monotrichous; gram negative; capsulated; non-spore-former; not acid fast; colonies on potato-dextrose agar plates are circular with entire margins, smooth, shining, convex, colour Baryta yellow (Ridgway), no distinctive odour; gelatin liquefied; starch not hydrolysed; casein digested; milk slowly peptonised; litmus reduced; hydrogen sulphide and ammonia produced from peptone; nitrate not reduced; M.R. and V.P. tests negative; acid but no gas from dextrose, maltose, sucrose, lactose, glycerol; no growth in salicin and dextrin; optimum temperature for growth 27-29° C., thermal death point 53° C., pathogenic to *Phaseolus trilobus* Ait. only, producing spots on leaves. Found at the Agricultural College Farm, Poona.

Fuller details will be published elsewhere.

Plant Path. Lab.,                      V. V. BHATT.  
Agric. College,                      S. G. ABHYANKAR.  
Poona, July 16, 1956.                      M. K. PATEL.

#### *PYTHIUM CATENULATUM* MATTHEWS CAUSING SUGARCANE SEEDLING ROOT ROT

AMONG the fungi isolated from sugarcane seedlings killed by root rot were a few isolates which were identified as *Pythium catenulatum* Matthews. This organism which has few records about its occurrence abroad was described from America.<sup>2</sup> It has been reported once in India by Balakrishnan who found it growing on decaying vegetable matter and parasitizing *Spirogyra*.<sup>1</sup> He did not observe the sexual stage and based his identification on the characters of the asexual stage alone.

The sugarcane organism is characterised by sporangia which consist of slightly inflated hyphæ or irregular swellings germinating by the liberation of 20 to 30 reniform zoospores ( $6-8 \mu \times 6-10 \mu$ ) from a vesicle formed at the end of a narrow emission tube. A number of catenulate, spherical to pyriform vegetative bodies occur on the hyphæ,  $12-22 \mu$  in diameter, and these germinate by germ tube. The sexual stage is produced on maize meal agar but not on a number of other natural and synthetic media including boiled carrot slices found favourable



for this by Matthews.<sup>2</sup> Oogonia are terminal or intercalary, smooth, thin-walled, 20-35  $\mu$  in diameter; antheridia monoclinal or diclinal upto 12 (usually 6) distributed more or less at equal distances around the oogonium, clavate, crook-necked, in narrow apical contact with the oogonial wall; oospores single, smooth-walled, plerotic, 16-28  $\mu$  in diameter (Fig. 1). Germination of the oospores was not

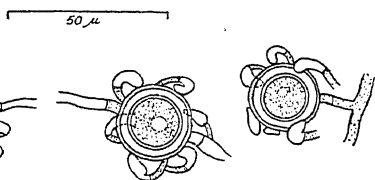


FIG. 1. *Pythium catenulatum*. Sexual Apparatus.

secured. Observation of the sexual stage confirms the existence of this species in this country.

Inoculation of sugarcane seedlings, two to four weeks old with zoospore suspensions or by raising sugarcane seedlings on sterilized soil in which a sand and oat culture had been incorporated resulted in deaths due to root rot. Controls were healthy and the pathogen was reisolated from affected plants. Seedlings over three months old could not be infected. To the knowledge of the writer there does not appear to be any previous record of this organism parasitizing any of the higher plants.

Grateful thanks are due to Mr. N. L. Dutt, Director of this Institute, for encouragement.

Sugarcane Breeding Inst., K. V. SRINIVASAN.

Lawley Road P.O.,

Coimbatore, May 28, 1956.

1. Balakrishnan, M. S., *Proc. Indian Acad. Sci.*, 1948, 28B, 27.

2. Matthews, Velma, D., *Studies on the Genus Pythium*, Univ. North Carolina Press, 1931, p. 47.

### SPONTANEOUS VARIEGATED CHIMAERA IN *DIANTHUS CHINENSIS* L.

SPONTANEOUS occurrence of variegated chimæras<sup>1</sup> has been of late rather common involving different species of plants grown for horticultural purposes in the Botanical Gardens of this College. The species involved were cultivated variety of *Dahlia* (half the capitulum on one branch bearing white flowers—the other half being coloured as normal), *Helianthus annuus* (parts of two of the leaves developing yellow sectors) and *Dianthus chinensis*. The present communication reports the detailed study of a variegated chimæral branch of *D. chinensis*,

which arose as a sport in a homogeneous population of this horticultural variety.

Of the nine branches arising in a cluster from one seedling of *D. chinensis*, only one branch developed variegated chimæra. On close examination it was seen that the basal part of this branch was green all round, but 3 cm. above the ground-level, from the first node, a very narrow yellowish sector appeared which widened its breadth gradually upwards upto the extreme apex. It may be seen from Fig. 1



FIG. 1

that the albino sector stands out prominently beyond the first node of the affected branch and there is close parallelism in the production of green or albino branchlets as they arise from the green or albino sectors. The first branchlet arising from the green sector is normal green without even a streak of albineness whereas the other two branches arising from the second and fourth node are purely albino types without a streak of greenness. Leaves which have their origin partly in both the sectors produce albino and green segments of the lamina in strict conformity with the points of origin. When a flower is borne on the albino branch its bracts and sepals are also albino and the petals are faintly coloured. But a flower terminating a partly albino branchlet develops corresponding green and albino portions. Therefore, on the chimæral branch were produced branchlets, leaves and flowers of 3 categories: (a) all parts green and normal, (b) partly green and partly albino sectors, and (c) all parts albino.

Pure albino and normal flowers were selfed and bagged and their seeds collected. It was seen that flowers on the green branch produced on an average 45 seeds each, two flowers on the albino branchlets produced only 2 and 6 seeds respectively, despite the fact that 95% of the pollen grains in the albino flowers stain-

ed red with acetocarmine. The viability of these seeds has not yet been tested. If the 8 seeds from the albino flowers do at all germinate, it is expected that these will produce albino seedlings which may die out at an early stage.

Transverse sections of the branch and branchlets and leaves at various positions showed interesting features in the development of chloroplasts. The branches showed sectorial (Fig. 2) pure albino and pure green chimæral

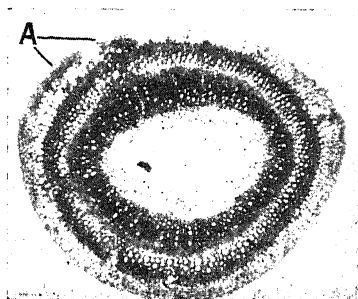


FIG. 2

pattern in the development of chloroplasts. The albino sectors of leaves which were crumpled externally were devoid of chloroplasts—although palisade and spongy tissues in the green sector of the same leaf contained normal chloroplasts. Pure albino leaves were smaller than the pure green ones. In this respect our findings are in agreement with those of Weiss<sup>2</sup> and Tandon and Vasil.<sup>3</sup>

Obviously, the production of the variegated chimæral branch amidst a cluster of nine branches from a seedling of *Dianthus chinensis* was induced by environmental conditions at a very young stage when branch buds were being differentiated and that it arose as a 'sport' or bud mutation involving only a sector of the apical meristem. This claim may be substantiated by the occurrence of sectorial chimæra in *Dahlia* flower under similar conditions of the environment. The mutation in *Dianthus* not only inhibited the development of normal chloroplasts primarily,<sup>2,4</sup> but also appreciably reduced the seed output, when the flowers were selfed.

Ravenshaw College,  
Cuttack, May 20, 1956.

C. M. BASTIA.  
G. PANIGRAHI.

## A THERMOSTATICALLY CONTROLLED MINIATURE GLASS-HOUSE

IN physiological studies in the uptake of metabolites and consequent tissue changes in plants under the influence of antibiotics in the soil, the need for a constant temperature miniature glass-house became urgent. One such was constructed and is described here (for the benefit of workers in this and related fields of research)

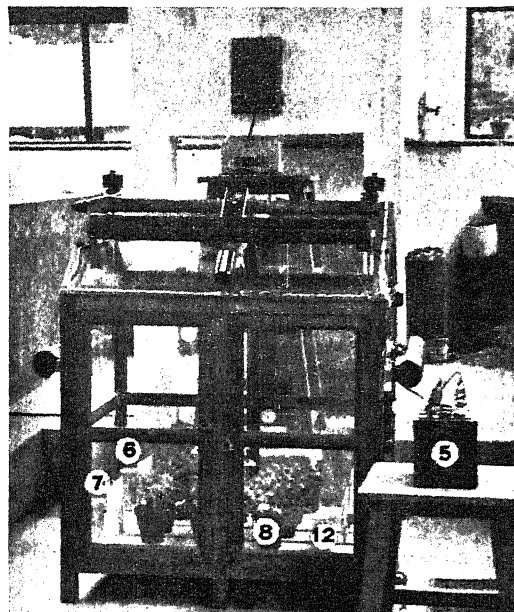


FIG. 1

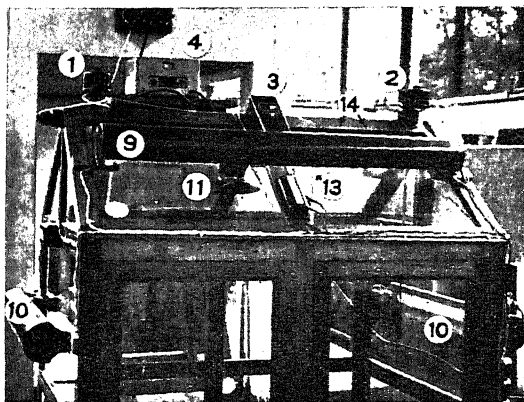


FIG. 2

1 and 2—Thermostats; 3—HVS relay; 4—battery charger; 5—6-volt battery; 6 and 7—200-watt heating units (4 nos.); 8—plants; 9, 10—four tube lights; 11—fan; 12—slatted floor board with wire-gauze support; 13—thermometer; 14— $\frac{1}{4}$ " air-holes on ridge.

1. Bastia, C. M. and Panigrahi, G., *Proc. Ind. Sci. Cong.*, 1956, Part III, 257.
2. Dermen, H., *J. Hered.*, 1950, **41**, 325.
3. Tandon, S. L. and Vasil, I. K., *Ind. Journ. Hort.*, 1954, **11** (1), 10.
4. Weiss, F. E., *J. Roy. Hort. Soc.*, 1940, **65**, 213.

as it has been found a most useful acquisition in experimental physiology.

The chamber is a wood and glass structure (Figs. 1 and 2) measuring 40" long, 28" wide, 45" at the ridge and 35" at the door with sloping roofs. Two sunvic dry thermostatic controls (Type TS. 3) connected in parallel through a HVS relay (Type F 102/3) operate four 200-watt dry heaters mounted on the floor in four corners protected by asbestos sheet baffles preventing direct radiation of heat on to plants. A miniature rubber blade 6-volt auto-fan is mounted on the roof operating on a 6-volt floating battery circuit (with a trickle charger unit). This fan keeps a feeble air circulation, as any large agitation would result in an exaggerated transpiration and vitiation of results. A number of  $\frac{1}{4}$ " holes, drilled into the wooden ridge, allows sufficient air inlet for the fan. Four tube lights are mounted on the outside of the cabinet, two on the sides and two on the roof with suitable reflectors and these are of known lux value to enable the investigator to undertake photoperiod work also (for instance, a miniature chamber covered with black cloth can easily be pushed into the cabinet for dark phase observations).

The chamber has been in continuous commission for months at various temperature levels and is not only trouble-free but also maintains accurately  $\pm 0.2^\circ \text{C}$ ., a couple of degrees above the atmospheric air temperature. The chamber is compact, takes as many as 16 fair-sized potted plants (4" pots) and can be used with advantage inside air-conditioned rooms, should the investigator desire to have lower temperatures in warmer parts of this country. Other details of the construction are clear from the labelled photographs. It is obvious that the chamber can be put to multifarious uses in plant physiological laboratories (including tissue culture work) and also for enzyme work in microbiological laboratories.

This chamber was constructed out of a generous grant to one of us (T. S. S.) under the personal grants scheme for research workers of the Ministry of Education, Government of India. We offer our thanks to Shri V. Mahadevan of the United Automobiles for help in designing, building and standardizing the equipment.

T. S. SADASIVAN.

(Miss) L. SARASWATHI-DEVI.

(Miss) C. B. SULOCHANA.

University Botany Lab.,  
Madras-5, July 30, 1956.

## SOIL APPLICATION OF 2, 4-D TO INCREASE SUGAR IN CANE

THE present authors, using the technique of large-scale experimentation involving milling tests at the factory, have recently reported<sup>1-3</sup> consistent increase in the sugar content of cane from foliar treatment with 50 p.p.m. solution of 2, 4-D (sodium salt). This note reports the results of preliminary work undertaken with the object of assessing the effect of applying the hormone through the soil.

The trial was conducted in duplicate in a large block under October planted B.O. 10 at Haripakhri Farm of Majhulia Sugar Factory, each of the treated and control plots being about half-an-acre in area. The treatment consisted of flooding the basal region of sugar-cane clumps with a 0.5% solution of a proprietary formulation containing 33% amine salt of 2, 4-D at the time of interculture in March and earthing up in June. On each occasion, 180 gallons of the solution were applied per acre, corresponding to a dosage of 3 lb. of the hormone. The plots were harvested in March (age 17 months) and subjected to milling tests at the factory. The results presented in Table I would indicate that soil application of 2, 4-D increases sugar content of cane and estimated recovery by 2.57-3.05 and 2.74-3.30 units respectively.

TABLE I  
Showing mill test data

Particulars	I		II	
	Treated	Control	Treated	Control
Sugar % cane	16.87	14.30	16.85	13.80
Fibre % cane	14.98	15.72	14.42	14.87
Purity crusher juice	91.06	89.92	91.26	90.16
Purity mixed juice	88.09	85.41	87.40	85.79
Mill extraction %	95.73	94.68	96.26	92.40
Estimated recovery	14.80	12.06	14.65	11.35
Improvement in estimated recovery	2.74	..	3.30	..

The treatment appears to have no appreciable effect on the yield of cane, average figures for the treated and control plots being 549 md. and 522 md. per acre respectively. Similarly, growth criteria at harvest are also not significantly affected.

It can therefore be tentatively concluded that soil treatment with a dilute solution of an amine salt of 2, 4-D in two doses of 3 lb. of the hormone per acre applied at the time of interculture and earthing up brings about a large increase in the sugar content of cane without appreciably affecting its growth or yield. Fur-

ther studies are in progress with a view to fully examining the possibilities of this method.

The authors wish to acknowledge the assistance rendered by Sri R. D. Sahi, Analytical Assistant, in the course of this work.

Central Sugarcane                      A. S. CHACRAVARTI.  
Research Station, Pusa,                D. P. SRIVASTAVA.  
June 1, 1956.                            K. L. KHANNA.

1. Chacravarti, A. S., Srivastava, D. P. and Khanna, K. L., *Indian Sugar*, 1955, 5, 171.
2. —, *Curr. Sci.*, 1955, 24, 316.
3. —, *Proc. Internat. Soc. Sugarcane Tech.*, 9th Cong., 1956.

#### NEMATODE GALLS ON A GRASS *DICANTHIUM ANNULATUM*

THE grass, *Dicanthium annulatum*, grows as a weed in fields, but mostly as a fodder on the bunds and also in the fallow lands. During August 1955 galls were collected on the leaves of this grass at Rajendranagar Farm and since then from many places.

Galled grasses occur in patches which gradually increase in size, and the attacked leaves may drop off. Galls are pinkish in colour when fresh, changing to dark purple later. These bulge out on both sides of the leaf, one portion being larger than the other. They are formed mostly on the leaves, but leaf-sheaths are no exceptions and in one case a gall was found on the stem. When the leaves are young and the attack is severe, they shrivel and dry up. The galled leaves may twist or join leaf-blades. Galls are found to occur mostly in the portions near to the soil. Usually these occur separately but sometimes may coalesce together and give a knotty appearance to the leaves (Fig. 1). When fresh galls are pressed pinkish liquid oozes out. The number of galls per leaf varies from one to seventeen.

Galls are small and are of the cynipid type. They are usually round with elliptical outline, hard when touched and are found on either side of the mid-rib; when cut open, a chamber full of nematode eggs, larvæ and adults is seen. The wall forming the cavity is 2-3 layers thick. A very small pore is seen on a mature gall, through which the larvæ escape and re-infest healthy leaves. Galls are found in nature from the beginning of the monsoon till the grass dries up in the summer. Galls formed on healthy leaves emerging from a rhizome of an infected plant (perhaps some larvæ might have been lying on the stem). The upper and lower portions of the gall measure 2.2 mm. to 4.1 mm.  $\times$  1.66 mm. to 2.77 mm. and 1.1 mm. to 1.7 mm. respectively.

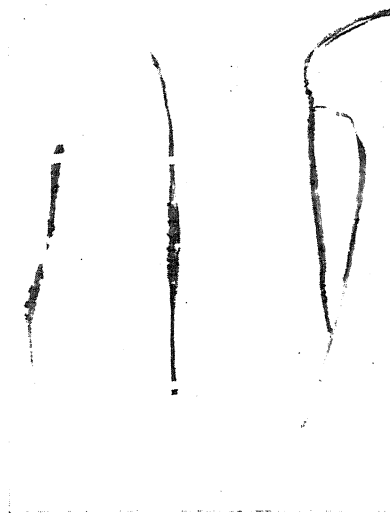


FIG. 1

Galls on grass, *Dicanthium annulatum*.

Hundreds of eggs and larvæ and a limited number of adults, usually 2-4 in each sex, are found in a gall. Nematodes are glistening white and sometimes the females become plumpy and appear opaque. When the eggs hatch, the larvæ coil into a mass, and when put in a drop of water they begin to move fast. Eggs are large and range from  $93-102 \mu \times 37-37 \mu$ ; the average being  $95 \mu \times 37 \mu$ . More than 200 eggs have been found in a single gall.

Males are slender and shorter and measure  $1,018$  to  $1,277 \mu \times 56$  to  $74 \mu$ . Females are large and stumpy and measure  $925$  to  $2,387 \mu \times 37$  to  $148 \mu$ . Larvæ vary in size between  $426$  and  $1,018 \mu$  and  $14$  to  $56 \mu$ . The nematode causing galls on the grass, *Dicanthium annulatum*, has been provisionally identified as *Anguina* sp. (Family: Tylenchidæ).

Grateful acknowledgement is due to Dr. Syed Vaheeduddin, for facilities, to Sri. D. V. Subba Rao, for help in collecting the material, to Dr. M. R. Saxena, for identifying the host, and to Dr. S. N. Singh and Sri. Dass for identifying the nematode.

Main Experimental Farm,                      D. BAP REDDY.  
Rajendernagar.  
Hyderabad (Dn.), July 6, 1956.

#### METAMICT HEMATITE

IN the course of some investigations on low grade uranium ores it was found that the hematite in it gave an extremely weak and

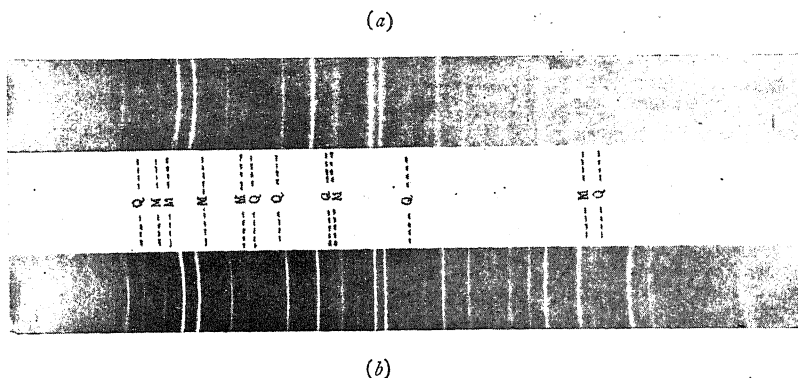


FIG. 1

Powder diffraction pattern of (a) original metamict and (b) heat-treated hematite. The lines due to the impurities magnetite (M) and quartz (Q) are marked.

diffused front reflexion X-ray pattern shown in Fig. 1 a. This suggested the possible occurrence of the mineral in a metamict state (absence of long-range order of lattice). The mineral sample was therefore heated to 1,000° C. for 48 hr. in an atmosphere of pure nitrogen. The sharp pattern obtained from this heated sample is shown in Fig. 1 b. An analysis of this revealed the presence of hematite as a primary constituent with some magnetite (~10%) and silica (~10%).

The occurrence of hematite in the metamict state and its reconstitution are established as can be clearly seen in Figs. 1 a and 1 b. A detailed account will be published later.

Chemistry Division, M. D. KARKHANAVALA.  
Atomic Energy Establishment,  
Bombay, August 4, 1956.

#### A LARGE OVERTHRUST STRUCTURE NEAR DEBIPUR (BARAKAR), WEST BENGAL

THERE is a well-defined overthrust of length over 3 miles, seen at a distance of about 6 furlongs west of Debipur (Longitude 86° 6' E. and Latitude 23° 4' N.). This huge overthrust has brought the older gneisses above the younger shales of Talchir stage over a low-angled thrust plane not found in previous literature.

There are many evidences to confirm the presence of this overthrust structure. The direction of movement was N.E.-S.W. and is well-marked on the quartzites of this area,

which show a foliation N.W.-S.E. direction. This feature is not seen in the quartzites anywhere else in Barakar. Huge piles of quartz pieces are seen scattered over a large area in the vicinity of the overthrust structure. Owing to the thrusting and the shearing, the Talchir shales have become splintery, slaty and crushed. The gneisses which have their original dip in the north-east direction are caused to dip in the south-west direction over the Talchir shales. One of the most convincing evidences is the occurrence of pieces of gneisses in the Talchir shales. These forcefully included or rather snatched pieces are of various shapes, rounded and angular, and these must have got caught up in the shales which provided a plastic medium during the movement. These shales containing the gneiss pieces cannot be mistaken for Talchir boulder beds, as we studied the boulder beds earlier in the neighbouring areas, which contained varieties of rocks, basic, acidic, unaltered feldspars, glaciated and striated pieces, etc. Nevertheless, one very interesting and curious feature is the igneous rock appearance of the Talchir shales. Nowhere was a piece of fossil found in them, and the mode of occurrence too resembles that of altered traps. It is very difficult for us, at this stage, to say anything definite regarding this curious rock. It may, however, provide a basis for further investigations on the Talchirs of other areas.

Dept. of Geology,  
Banaras Hindu University,  
May 5, 1956.

D. N. RATH.  
S. RAMARATNAM.  
S. B. KAR.

## REVIEWS

**High Polymers Polymer Processes.** Edited by C. E. Scheldinecht. (Interscience Pub.), 1956. Pp. xvii + 914. Price \$19.50.

Quite a few books have appeared on high polymers during the past two decades; but the general tendency has been to lay the stress exclusively either on the fundamental or the applied aspect. The volume under review is a notable exception, and combines both the aspects admirably and may be said to bridge the gap between theory and practice.

In the first five chapters running to nearly 200 pages, recent developments of fundamental interest related to addition polymer processes have been dealt with polymerizations in bulk, suspension, emulsion, and solution with a number of illustrated diagrams of the reactors, etc., given. The next chapter on ionic polymerization, written by the editor, is brief, but very illustrative with reference to preparation of butyl rubbers. Chapters on polyamides and polyesters by Bannerman and Magat and on condensation with formaldehyde by Suen are also short but understandable in view of the number of monographs that have already appeared on the subject. Treatment on fibres and films is cursory. Recent developments, especially in the technology of epoxy resins and polysulfide polymers, have been nicely summarized in two separate chapters. A series of subjects essential to a plastics engineer and technologist, like paste technique, adhesives, stabilization of polymers, latex techniques, etc., have been brought together for the first time in this volume.

Compounding and processing of rubbers and resins by Garvin of Goodrich Chemical Co. has received a treatment with a bias for a theoretician. Processes like film casting, spread coating, dip coating, block skiving, calendaring, etc., could have been more illustrative. But the chapter forms an exhaustive catalogue of various types of processing with various plastics. The last two chapters on 'polymer reinforcement and spinning and drawing of fibres' have been dealt with exhaustively with a series of illustrations, fabrication techniques like bug moulding, molding of glass fibre, impregnation, fibre drawing, spinning processes, etc.

The bulk of the material given in the book will be of great interest and value to the plastics technologist. To the polymer chemist

engaged in research, the volume under review is an eye-opener to the multifarious industrial aspects of high polymer technology.

M. SANTHAPPA.

**India's Mineral Wealth.** By J. Coggin Brown and A. K. Dey. (Oxford University Press, London), 1955. Pp. 760. Price Rs. 30.

This well-known publication, which was unprocurable for many years, has now emerged in its third edition in a revised form. It has been brought up to date in information and statistics. India is rich in mineral resources and it has been conceded that hardly the surface deposits have been worked in many cases. The assessment of the country's potential reserves has been made in some cases and will be the subject of detailed investigations in the near future.

The first part of the book deals with the mineral fuels and details of geology, occurrence and classification are recorded. In an exhaustive description of metallic ores, the salient features of the origin, occurrence and association of the precious metals, minerals and ores of iron, non-ferrous and light metals are discussed together with the all too important atomic minerals. Attention has been drawn to the less familiar metals and their ores. The next part deals with materials used in construction such as building stones, slates and marbles, ceramic raw materials, glass sands, minerals used in industry as ochres, corundum, phosphates, the micas and many others. A separate section on the precious and semi-precious stones found in India together with their uncommon counterparts would be found valuable. The last part deals with water supplies and soils. There is an exhaustive bibliography to help readers and an appendix recording mineral production for the three years ending 1953.

There are several maps of the geology of India and adjoining countries and mineral-bearing areas in these countries. There are many plates and graphs recording production of the different commodities. The statistical value of the book lies in the great many tables which are given for almost every mineral cited in the book.

The authors deserve considerable praise for compiling such a useful publication which

should be an asset to institutions and individuals interested in the country's mineral wealth.

N. R. SRINIVASAN.

*Antibiotics Annual, 1955-56.* Edited by Henry Welch and Felix Marti-Ibanez. (Medical Encyclopædia, Inc., New York, N.Y.), 1956. Pp. xvii + 994. Price \$10.00.

Those who have gone through the two previous issues of the *Antibiotics Annual*, must be impatiently waiting for the Third Annual Number covering the proceedings of the Third Annual Symposium on Antibiotics held in Washington, from November 2nd to 4th, 1955. The present volume contains 150 reports contributed to the symposium and in addition, there are extremely instructive reports of the three panel discussions on the important subjects, "Long-Term and Prophylactic Use of Antibiotics", "Penicillin V", and "True Significance and Real Incidence of Reactions Following Clinical Use of Antibiotics". There are 12 papers on Penicillin V which has now shot up into limelight after five years of dormancy, and reports on 12 new antibiotics. It is impossible to make even a passing reference to all the significant findings reported and it would suffice to say that the volume is a mine of information and a "must" for all researches on antibiotics to read, though the bias is on the clinical side. There is the sound advice to the clinician: "The ideal thing would be to use the 'umbrella' of antibiotics only in real pathological storms, and not for passing summer showers". But the manufacturers of antibiotics would prefer the use of the 'umbrella' even against suspected drizzles!

There are contributions from authors from 15 countries, India included; but conspicuous is the absence of any from Britain, USSR and the East-European countries. This will probably be remedied in subsequent years; as the message of President Eisenhower says: "Such international co-operation and understanding goes far in improving the health of all the people. A world mentally and physically healthy will be a peaceful world". The following passage significantly enough also occurs in a fascinating article by Marti-Ibanez: "Health, like peace, will have to be created in the future through a peaceful and benevolent co-existence with germs and political opponents, independent of chemotherapies or atomic bombs. Disease prevention by the creation of conditions that will improve physical and mental health will lead to the creation of healthier mentalities and

cleaner thinking... Wars are conceived in men's brains, before they are fought out on the battlefield."

K. GANAPATHI.

*Treatise on Inorganic Chemistry, Vol. I.* By H. Remy (translated by J. S. Anderson). (Elsevier Publishing Co.), 1956. Pp. xv + 866. Price £ 5 5 sh.

Remy's *Lehrbuch der Anorganischen Chemie* has been occupying a high place among the standard and authoritative text-books in advanced inorganic chemistry, ever since its first publication in 1931. It has since run into eight editions. The popularity enjoyed by this treatise is not a little due to the successful manner in which the factual material of inorganic chemistry has been systematised by fitting it into a coherent framework of thermodynamic, kinetic and structural principles.

The volume under review is Vol. I of the first English translation of Remy's treatise. Though it is based on the 7th and 8th German editions, the English edition has been made more up to date than the original, by incorporation of additional matter, especially in the chapters dealing with nuclear chemistry, trans-uranic elements, etc. The present volume deals with the chemistry of the elements of the 'main groups' of the periodic table, while the chemistry of the 'sub-groups' along with general topics like radioactivity, catalysis, non-aqueous solutions, etc., have been reserved for the second volume to be published.

Of the 18 chapters of Vol. I, only 9 are devoted to the discussion of the descriptive chemistry of elements and their compounds. The remaining 9 chapters deal with general topics of fundamental significance such as "The Periodic System", "Volume and Affinity", "Crystal Structure and X-rays", "Constitution and Properties", "Hydrogen Spectrum and the Structure of the Hydrogen Atom", etc. No efforts have been spared in giving as lucid an exposition as possible of the modern aspects of atomic and molecular structure. The judicious combination of chapters on descriptive chemistry with chapters on theoretical chemistry and physics is indeed an excellent idea, which brings home to the student the necessity of gaining good familiarity with modern theories for a proper appreciation and co-ordination of the factual aspects of inorganic chemistry. This mode of treatment elevates inorganic chemistry from a mere collection of facts and data to the status of a systematic and unified science. The descriptive chapters contain, besides information on

the occurrence, preparation and properties of elements and their compounds, also short notes on their analytical chemistry. The value of the book is considerably enhanced by useful appendices containing a table of atomic weights, the periodic table and a list of publications recommended for further study.

This well got up and well-written volume commends itself as a standard text-book for students of higher inorganic chemistry.

A. P. MADHAVAN NAIR.

**Methods of Biochemical Analysis, Vol. 3.** Edited by David Gluck. Interscience Publishers, New York, 1956. Pp. x + 439. Price \$9.50.

Rapid advances in the field of biochemistry have been made in recent years, mainly due to development of methods and techniques for the determination of biologically important substances. The need for an authoritative collection of these methods and techniques is readily admitted. Dr. David Gluck has rendered yeoman service by editing this series on methods of biochemical analysis. With the assistance of an international advisory board, he has made a judicious selection of topics so as to emphasize innovations and developments of current interest.

In the volume under review, which is the third in the annual series, a dozen methods of biochemical analysis have been described by authors who have had considerable experience in the successful adoption of these methods or techniques in different biochemical investigations. Among these, mention may be made of organic phosphorus determinations by Lindberg and Friester, assay of thioctic acid by Stokstad and his colleagues, histamine determination by Cole and McIntire, enzymic microdetermination of uric acid, hypoxanthine, xanthine, adenine and xanthopterin by Plexner and Kalekar, and the use of periodate oxidations in biochemical analysis by Dyer. In the carbohydrate field, there are two articles, one on end group analysis of polysaccharides, by Smith and Montgomery, and the other on the use of infrared analysis in the determination of carbohydrate structure, by Barker, Bourne and Whiffen. These are followed by three articles in another field, consisting of the measurement of complex ion stability by the use of ion-exchange resins, analysis of metal protein complexes and applications of metal buffers and metal indicators in biochemistry, and will be of special interest to those dealing with physico-chemical problems. The last two articles are, however, of

more general interest, one on the estimation of zinc in biological materials and the second on the principles and applications of flame photometry and spectrometry. On the whole, the subjects have been well chosen, and though in the treatment of many of them, instruments of American origin have been specially mentioned, biochemists in other parts of the world will not find any great difficulty in adapting these methods to suit their own equipment. It must be emphasized that the ready availability in recent years of spectrophotometers, pure enzymes and pure strains of micro-organisms has given a great stimulus to many research workers to develop and perfect several new methods of biochemical analysis.

The get-up of the book is of a high standard which one has come to expect of Interscience Publishers. There is, in addition, an extremely useful cumulative index for all the three volumes so far published in this series.

P. S. SARMA.

**Transactions of the Archaeological Society of South India, Vol. I.** (Published by the Society, Madras), 1955. Pp. x + 143.

This volume of Transactions comprises eight articles, mostly lectures delivered at the Society, besides a short introduction by the President of the Society, Justice A. S. P. Ayyar, and a foreword by a former President, Dr. A. L. Mudaliyar. While the publication of the Transactions of a learned society is always to be welcomed, it cannot be said that this volume quite meets the expectations it raises. In a publication of this type, scholars look naturally for original thought and reports of fresh discoveries. From this point of view there is very little new ground taken by any of the contributors. The only partial exception is the paper on 'Some Interesting Antiquities of Tulu-nad' by P. R. Srinivasan; but even he draws more from books than from his own observations. The first paper 'Temple and Pyramid and Obelisk' and the last 'Origin and Growth of Religion: Indian Evidence', both by Mr. T. G. Aravamudan, attempt fresh interpretations of known data, but speculation often outruns the evidence cited. We hope that the publication of these Transactions will become a regular feature hereafter and that they will contain reports of really original papers and discoveries like the Transactions of similar learned Societies elsewhere.

K. A. N.



## Books Received

*Investigations on the Theory of the Brownian Movement.* By Albert Einstein. (Dover Publications, N.Y.), 1956. Pp. 119. Price \$ 1.25.

*Currents in Biochemical Research.* Edited by David E. Green. (Interscience Pub.), 1956. Pp. xvi + 697. Price \$ 10.00.

*Anatomy of the Honey Bee.* By R. E. Snodgrass. (Cornell University Press, New York), 1956. Pp. xiv + 334. Price \$ 6.00.

*History of Analytic Geometry.* By Carl B. Boyer. (Scripta Mathematica, New York 33, N.Y.), 1956. Pp. ix + 291. Price \$ 6.00.

*Mechanical Testing and Inspection of Engineering Materials.* By J. H. Lamble. (Cleaver-Hume Press, Ltd., London), 1956. Pp. 460-98. Price 3 sh. 6 d.

*Report of the Rothamsted Experimental Station for 1955.* (Harpenden Rothamsted Experimental Station, Harpenden, Herts.), 1956. Pp. 255. Price 8 sh. 6 d.

## CHEMICAL APPLICATIONS OF SPECTROSCOPY\*

THE present volume is a very valuable and welcome addition to the series publication—"Technique of Organic Chemistry", edited by Dr. Arnold Weissberger. Like its predecessors, it is a collaborative work containing contributions from well-known experts in the respective fields.

Applications of various physical methods for the study of organic compounds have now become a routine procedure in all laboratories. In many of these methods the experimental data are easily interpreted and can be effectively utilised in the solution of chemical problems with very little of theoretical knowledge. But the case is slightly different as regards the applications of spectroscopic methods in organic chemistry. It is easy to accumulate data on the absorption spectra of organic compounds both in the ultra-violet and infra-red regions, but it is difficult to interpret them. A knowledge of the theory of spectra is essential before one could interpret the data successfully. In the present volume on the chemical applications of spectroscopy, the emphasis is therefore on the theoretical aspect. It serves as an introduction to the interpretation of the spectra of organic compounds.

The book is divided into six chapters. Most of the chapters deal with the theory of spectra and the interpretation of experimental observations. The spectral region covered extends from microwave to ultra-violet radiations. Only brief descriptions of the experimental procedures have been given, but these are supplemented by a comprehensive list of references to original papers.

Chapter I on "Introductory Survey of Molecular Spectra" has been written by Dr. W. West. It contains an account of the spectroscopic units and nomenclature and the general features of the spectra of atoms and diatomic molecules. It also contains a brief survey of the quantum mechanical description of the electronic states and the methods of atomic and molecular orbitals. This introductory chapter forms an excellent basis for understanding the spectra of more complicated molecules dealt with in the subsequent chapters.

The second chapter on microwave and radio-frequency spectroscopy has been contributed by Prof. Walter Gordy, who is a well-known authority in the field. This subject covering the spectral region from about 1 mm., bordering on the long-wave infra-red region, up to those of the familiar radio waves, has come into prominence since World War II. The development of practical methods in this branch of spectroscopy in recent years has contributed powerful tools for the study of structure of matter, beside X-rays and electron diffraction. Their potentialities as a powerful method for chemical analysis have not yet been fully exploited. Prof. Gordy gives a lucid exposition of several important aspects, such as nuclear quadrupole coupling and its relation to chemical binding, nuclear magnetic resonance and the application of microwave spectroscopy, to the analysis of substances of great biological importance such as phthalocyanine, chlorophyll, hæmoglobin, proteins and amino acids.

In Chapter III, Prof. A. B. F. Duncan presents the theory of infra-red and Raman spectra of polyatomic molecules. Group theoretical methods which are increasingly applied to the problem of molecular vibrations, their selection rules and intensities have been described and illustrated with appropriate examples.

\* *Chemical Applications of Spectroscopy—Technique of Organic Chemistry*, Vol. IX. Editor: W. West. (Interscience Publishers), 1956. Pp. xxiv + 787. Price \$ 15.00.

The next chapter by Drs. R. N. Jones and C. Sandorfy is on the applications of infra-red and Raman spectrometry to the elucidation of molecular structure. This chapter is the longest in the volume, reflecting the current interest of organic chemists in infra-red spectra. The most important contribution is the comparative study of the frequencies characteristic of specific groups of atoms in a number of organic molecules, which appear in the infra-red and Raman spectra. All available data have been collected, analysed, and presented in the form of tables and figures. A detailed discussion of the characteristic group frequencies has also been included. In recent years the emphasis has been on the importance of accurate measurements of intensity in the infra-red region. The authors have therefore included in this chapter a comprehensive analysis of the ideal and of the experimental conditions appropriate to such measurements.

Chapter V on the electronic spectra in the visible and ultra-violet regions consists of two parts. The first part written by Prof. A. B. F. Duncan on the theoretical aspects embodies a comprehensive treatment of the atomic and molecular orbital theories of the electronic states of molecules. The second part by Prof. F. A. Matsen contains a detailed description of the three main structural components of electronic spectra, *viz.*, the single bond, the multiple bond and the basis group and the effects due to substitution, hyperconjugation, etc., on these. A number of general topics connected with electronic spectra such as complexes, effect of change of state, colouring matters and dyes have also been discussed.

The last chapter on fluorescence and phos-

phorescence contributed by Dr. West contains a summary of the general features of these phenomena as observed in organic substances. The relation between rigidity, planarity, ring-closure, etc., and fluorescence has been illustrated by choosing a number of examples. An excellent discussion is also given on the explanation of Lewis and Kasha that the phosphorescent emission is due to triplet-singlet transitions and its intensity is governed by spin orbital interaction. The quantum yield of phosphorescence and the triplet levels and thermochromism are also briefly discussed.

The book thus covers practically the whole field of spectroscopy from the millimetre wave to the far ultra-violet. The theories are presented in a simple manner so as to be easily understood by non-mathematical chemists and the chapters dealing with the interpretation of data contain a number of tables and illustrative diagrams.

The principal symbols used in the book which number well over two hundred and fifty have been tabulated and presented along with their definitions under the heading "Symbol Index" at the beginning of the book. This will be very helpful to the reader. There is also the usual subject index at the end of the book. The absence of author index is rather disappointing.

This book should find a place not only in every organic chemistry laboratory but also in every laboratory where work on problems of chemical physics is carried on.

Considering the wide range of topics discussed and that too in great detail the cost of the book does not seem to be high.

R. S. KRISHNAN.

---

## SCIENCE NOTES AND NEWS

---

### Tandem Vande Graaff Generator

A new type of particle accelerator for study in continuous detail of the nuclear energy levels of heavy elements will be installed by Atomic Energy of Canada Limited at Chalk River early in 1958.

The new machine consists of two specially designed Van de Graaff generators placed end to end in a horizontal position, giving the accelerator an overall length of 34 ft. and a diameter of 8 ft. The 35-ton accelerator will be mounted on a rail in an L-shaped building, 150 ft. long and 60 ft. wide. The building now

under construction at Chalk River is located against a hillside so that the ground on one side will act as the shielding against high-energy radiation. Thick concrete walls will shield other sides of the building. A separate building will house controls and services.

The beam of high-speed particles produced by the tandem accelerator will be focussed and deflected in a series of powerful electromagnets into an experimental area 25 ft. from the accelerators. The machine will be equipped with a switching magnet that will make it possible to shift the particle beam into any one of five

directions, depending on the type of study under way.

The accelerator will incorporate a novel method of charge exchange whereby the electric charge of a nuclear particle is changed during acceleration to very high speed, permitting the same five-million-volt potential to impart the equivalent of a ten-million-volt beam to the particle.

Essential to the operation of the tandem-style Van de Graaff accelerator is a source of negatively charged hydrogen ions. Credit for the development of such a source is due to Professor R. G. Herb and his associates at the University of Wisconsin. With Professor Herb's source, positive hydrogen ions are made negative before being accelerated into the Van de Graaff. At the half-way point of acceleration, negative ions are stripped of their excess electrons so that they can accelerate "down-hill" using the same high voltage.

#### Automatic Rainfall Stations in Japan

A network of robot weather stations has been created by the Central Meteorological Observatory of Japan to give timely warning of heavy rainfall in the mountains where manned observation posts would be difficult to maintain.

The equipment of each station consists of six parts: a rain-receiving unit, a meter to measure the volume of rain, a coding unit which translates these measurements into Morse Code signals, a programme clock for timing, a transmitter and a power unit which provides electricity for the mechanical operation and for the transmission. The stations have sufficient power to operate for six months unattended. From spring until late autumn the stations send out hourly signals in Morse Code recording rainfall amounts in millimeters.

#### Hydraulics Research at Kharagpur

Professor Otto Walch, who drew up the plans for the Hydraulics Laboratory now operating at the Indian Institute of Technology, Kharagpur, has just completed a 4-year mission to India under the UNESCO technical assistance programme.

In the new laboratory, water from a 60,000-gallon tank is pumped through seven flumes—steel troughs varying from 20 ft. to 60 ft. in length and equipped with thick plate-glass observation windows in their sides—in order to permit study of the behaviour of scale models of dams, locks, canals, and other forms of water-way construction. Delicate measuring instruments have been supplied to the laboratory with the aid of a \$30,000 UNESCO grant.

#### Prize for Essay on Relativity

The Teyler's Foundation and the Teyler's Second Society, Haarlem, are offering jointly a prize for an essay on "The absolute relations, on time and space, between actual events, as brought to light by the theory of Einstein, and the interest which the new insight concerning these might have for views in other domains of knowledge." The prize will consist of a gold medal, worth 400 Dutch florins, or, if the recipient prefers it, this amount in cash. The essays may be in Dutch, French, English, or German, and must be submitted by January 1, 1957. Further information can be obtained from the Directeuren van Teylers Stichting, Fundatiehuis Damstraat 21, Haarlem, Netherlands.

#### Advanced Training in Nuclear Research

The Fund for Peaceful Atomic Development, 2,000 Second Ave., Detroit 26, Mich., has published a pamphlet entitled, *Nuclear Science and Engineering Training in the United States*, listing the facilities available at selected colleges and Universities and at the national laboratories of the U.S. Atomic Energy Commission. The publication has been prepared especially for the use of students from outside the United States who are interested in graduate training in the U.S.A. The material is in summary form and is intended as a guide in the selection of institutions for advanced training.

#### Standard Translations of Russian Periodicals

A new expanded programme for the translation and publication of four leading Russian physics journals is announced by the American Institute of Physics with the co-operation and support of the National Science Foundation. The Journals are: *Zhurnal Tekhnicheskoi Fiziki* (Journal of Technical Physics), *Akusticheskii Zhurnal* (Acoustics Journal), physics articles from the *Doklady Akademii Nauk USSR* (Proceedings of the USSR Academy of Sciences). First issues of the translated journals will appear soon. The Foundation and the American Institute of Physics have already successfully collaborated in the publication of Soviet Physics—JETP, a bi-monthly translation of *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki* (Journal of Experimental and Theoretical Physics), six issues of which have now appeared. In addition to the programme in physics, the Foundation is supporting translations of Russian papers in mathematics and biology; and plans for the fiscal year 1957 include the earth sciences and the engineering sciences.

Translated by competent, qualified scientists, the publications will provide all research laboratories and libraries with accurate and up to date information of the results of research in the USSR. Subscriptions should be addressed to the American Institute of Physics, 57 East 55 Street, New York 22, N.Y.

### Mineral Beneficiation and Extractive Metallurgical Techniques

A symposium on the above subject is to be held on February 5-8, 1957, under the auspices of the National Metallurgical Laboratory at Jamshedpur, with the following sections: Ores dressing and mineral beneficiation of ferrous and non-ferrous ores; Thermal beneficiation and hydro-metallurgical upgrading of ores; Pyro-metallurgical extractive techniques; Electro-metallurgical extractive techniques and Extractive techniques based on chemical metallurgy methods. Technical papers are invited from technologists and scientists for the proposed symposium. Further details can be had from The National Metallurgical Laboratory, Jamshedpur-7.

### Second Congress on Applied Mechanics

The Second Congress on Theoretical and Applied Mechanics will be held in the National Physical Laboratory, New Delhi, on October 15-16, 1956. Dr. K. S. Krishnan, Director, NPL, New Delhi, will preside. The Congress is being sponsored by the Council of Scientific and Industrial Research.

Research papers contributed to the Congress will cover the following topics: Elasticity, Plasticity, Rheology; Fluid Mechanics (Aerodynamics, Hydrodynamics); Mechanics of Solids (Ballistics, Vibrations, Friction, Lubrication); Statistical Mechanics, Thermodynamics, Heat Transfer; and Mathematics in Physics and Mechanics, Methods of Computation.

Further information can be had from the Secretary-Treasurer, Second Congress on Theoretical and Applied Mechanics, Indian Institute of Technology, Kharagpur.

### Monographs on Algae and Fungi

A Conference of workers on algae was held on May 21 under the auspices of the Indian

Council of Agricultural Research to consider the question of bringing out monographs on various groups of algae. A similar Conference was also held on July 25 in regard to Fungi. Sri. M. S. Randhawa, Vice-President of the Indian Council of Agricultural Research, presided over both the conferences, and decisions were taken regarding the assignment of different topics to different authors. The following Editorial Boards were constituted. *Algae*: Shri M. S. Randhawa (Chairman), Dr. M. O. P. Iyengar, Dr. B. P. Pal, Dr. Ram Nagina Singh, Shri Ramanathan, Dr. P. L. Anand. *Fungi*: Dr. R. S. Vasudeva, Dr. B. L. Chona, Dr. P. R. Mehta.

Dr. U. N. Chatterjee will be in charge of the general editorial work relating to these series of monographs.

### Microfilm and Photocopy Service

The Indian Council of Medical Research established in 1948 two Microfilm and Photocopy Service Units, one at the Central Research Institute, Kasauli, and the other at the Tata Memorial Hospital, Bombay. Workers who desire to have microfilm or photocopy of any article are requested to communicate complete reference to the Officers-in-Charge of the Unit and the source, if known, of the Journal where it is available. The Unit will undertake to procure the journal and supply copies of articles in the minimum time possible.

### Award of Research Degree

The Osmania University has awarded the Ph.D. Degree to the following candidates for thesis on the subject noted against each. *Botany*: Shri P. Nanchar Rao, "Studies on Nutritional Requirements of *Trichoconis crotalariae* Sp. Nov. Some Parasite Fungi from Hyderabad Deccan"; Shri Abdul Rafique Zafar, "On the Periodicity and Distribution of Algae in Certain Fish Ponds in the Vicinity of Hyderabad, India"; *Chemical Technology*: Shri Sham Rao Nandapurkar, "Studies in Heat Transfer during the Condensation of Saturated Vapours"; Shri Balbheem Rao, "Studies of Hyderabad Clays"; and Shri N. Bhojraj Naidu, "Studies on Indigenous Vegetable Oils of Hyderabad State".

# COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

*Announcing the publication of :*

## GLOSSARY OF INDIAN MEDICINAL PLANTS

BY

Col. R. N. CHOPRA, S. L. NAYYAR & Dr. I. C. CHOPRA

(Size: 10½"×6"; Pp. xx+330)

Price: Rs. 8 per copy, Postage extra

An invaluable compendium of exhaustive information on the occurrence, distribution and uses of Indian Medicinal Plants with an index of their chemical constituents and vernacular names.

*For Copies, apply to :*

The Assistant Secretary, Publications Division

Council of Scientific & Industrial Research

OLD MILL ROAD, NEW DELHI 2

## INDIAN COUNCIL OF AGRICULTURAL RESEARCH

### INDIAN FARMING

Farmer's Own Magazine

Designed to serve the interests of the Indian farmers to a wide extent, **Indian Farming**, published in an attractive format, carries besides feature articles, topical notes, etc., special interviews with farmers and material for guidance of day-to-day farming operations. A popular monthly magazine for the public.

Annual Subscription : Rs. 9

Available from :

Single Copy : Rs. 12

### THE BUSINESS MANAGER

I.C.A.R., QUEEN VICTORIA ROAD

NEW DELHI

### INDIAN JOURNAL OF AGRICULTURAL SCIENCE

Annual Subscription: Rs. 15

(Quarterly)

Single Copy: Rs. 4

### INDIAN JOURNAL OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY

Annual Subscription: Rs. 12

(Quarterly)

Single Copy: Rs. 3

Available from :

THE MANAGER OF PUBLICATIONS

CIVIL LINES, DELHI 8

# Current Science

Vol. XXV]

OCTOBER 1956

[No. 10

	PAGE		PAGE
World Resources of Energy .. ..	313	Physiology of Hibernation of the Apple- Snail <i>Pila virens</i> (Lamarck)— (Miss) V. R. MEENAKSHI .. ..	321
Obituary—Meghnad Saha (1893-1956)— D. S. KOTHARI .. ..	315	Chromosome Number of Man .. ..	322
World's First Solar Electric Station ..	317	Letters to the Editor .. ..	323
XX International Geological Congress, Mexico, D.F. .. ..	318	Reviews .. ..	339
The Genus <i>Spiroclypeus</i> from Kutch, Western India—B. S. TEWARI ..	319	Science Notes and News .. ..	342

## WORLD RESOURCES OF ENERGY\*

THE population of the world has been steadily increasing, while the consumption of energy is also rising in every country consequent on the insistence on higher standards of living. If the present trends are to continue, it is clear that the demand for more power should be met from fresh sources of power. These considerations formed the background for the discussions of the Fifth World Power Conference held in Vienna in June this year. The projects put forward at the meeting were in fact promises for raising the standard of living everywhere.

Reviewing the availability of energy from natural resources such as coal, oil, water power, the Conference felt that while there are large resources of all these resources in the world, they are by no means limitless. Coal, for instance, is in short supply in many countries. Actual supplies of coal within the earth are still plentiful, but most of it lies too deep below the surface to be mined economically. Also, the demand is increasing rapidly, and the time will come when we can no longer afford to use

coal except for some specific purposes such as the manufacture of medicine, synthetic food, and a few others.

It has been estimated that in 1953, 56.2% of the gross energy produced in the world was derived from pit and brown coal. Petroleum and natural gas contributed 42% of world power, and energy derived from hydropower stations amounted to 1.8%. By 1975, however, the energy demands of the world will have increased three-and-a-half times, and in the year 2000, eight times as much energy will be needed. It is impossible to increase production of energy to this extent from the current resources. As needs expand, the amount of coal and oil available will decrease. The only other natural source of power which can be exploited still further seems to be energy from rivers and lakes, and several projects for gigantic water-power installations are envisaged in various parts of the world.

China, for example, is engaged in harnessing one of the mightiest waterways of her country, the Yellow River. The project, described during the World Power Conference, involves the construction of 46 dams which

\* With acknowledgment to *UNESCO Features*.

will prevent the disastrous floods experienced in the past and will produce 110 billion kilowatt-hours of electricity each year—some 35% more than the annual consumption of the highly industrialized Federal Republic of Germany.

Perhaps the greatest reserve of water power is hidden high in the Himalayan mountains, in the very heart of Tibet. It was pointed out that by building a tunnel ten miles long and diverting the Tsangpo River through it, a giant waterfall 6,480 feet high could be created. Once harnessed, its potential energy would be sufficient to produce 150 to 330 billion kilowatt-hours of electrical energy per year. This power would not only benefit the population of Tibet, but could also serve the aluminium industry of Assam and Bengal. With this additional energy, the industry would be capable of producing each year five times as much aluminium as the whole world produces to-day.

Even if such major schemes were realized, however, it would not mean that the world's hunger for power would be satisfied. Many European countries experience energy shortages which they are endeavouring to overcome by drawing on what might be described as 'un-conventional' power resources.

Here, without a doubt, atomic energy takes the lead. The United Kingdom has on hand a ten-year plan for the utilization of atomic energy for producing electricity. Under this programme, twelve nuclear power reactors with a total capacity of 1½ to 2 million kilowatts were to be completed by 1965. Technological progress in recent months, however, has already outdated this plan. During the Conference in Vienna, British scientists announced that, thanks to recent technical advances, 18 atomic power reactors can now be constructed within the same period, with a total capacity of 3 to 4 million kilowatts—about one-sixth of the entire electricity production in the United Kingdom in 1954. By further extensions of this programme, Britain expects by 1975 to produce as much as 25% of her total electricity from the atom.

As regards the United States, a country which owns other substantial energy resources such as coal, oil and water power, smaller reactors of various types are also being planned for use in less populated rural areas where needs are limited, as an important aspect of her programme for the development of atomic energy.

A report on Europe's needs of energy in the years to come and the resources from which they can be met has been prepared recently by a group of experts commissioned by the

Organization for European Economic Corporation.† This report emphasizes the fact that although the future energy prospects of the world have been fundamentally altered by the possibility of utilising nuclear power, this source is unlikely to provide more than about 8% of the total energy demand in Western Europe in 1975. It is a mistake to assume that atomic energy on a large scale is just round the corner, although there is no doubt that nuclear energy is sure to play a prominent part in later years.

A great deal of attention has therefore been paid to other types of economical power resources. It was reported in the Vienna Conference that scientists in Russia are endeavouring to exploit, on a large scale, energy from the sun. Valuable research has been carried out at the Krhizhanowsky Power Institute in the Ararat Valley in Armenia. In 1955, an experimental solar electro-generator was constructed, using a parabolic mirror 6 feet in diameter, in which the sun's heat is converted into electricity by means of semi-conducting materials. The USSR is also planning a much larger generator which, when completed in two or three years' time, should yield a capacity of 1,200 kilowatts and will be the largest yet built. Already a solar machine has been constructed in the Soviet Union which each day turns 1,000 litres of salt-water into fresh-water.

In France, an attempt is being made to exploit the energy resources of the ocean. On the river Rance, in Brittany, French engineers are building the first tidal power plant to operate on an economical level. The motion of the tides will be utilized by this plant to produce 342,000 kilowatts of electricity annually, and, if successful, a far bigger project will be undertaken which would increase the country's electricity production by one-third.

Another French project being carried out at Abidjan, on the African Ivory Coast, makes use of the difference in temperature between water on the surface of the ocean and water from the depths—in this area a difference of 75° F. A turbine operating a generator is placed over the steam current established between a vacuum evaporator in which the surface water boils spontaneously, and a heat exchanger in which steam condenses when entering in contact with the cold water brought up from the depths of the sea. When completed, this power station will have a capacity of 3,500 kilowatts.

† "Europe's Growing Needs of Energy: How can They be Met?" Published by O.E.E.C., Paris, 1956.

## OBITUARY

MEGHNAD SAHA (1893-1956)

THE life of late Prof. Saha has been an integral part of the growth of scientific research and organisation in our country, and the impact of his views and powerful personality will be felt for a long time to come in practically every aspect of the scientific activity. His dedication to science, his forthrightness and his utter disregard of personal comfort and interests in the pursuit of his chosen vocation will long remain an inspiration and an example.

Meghnad Saha was born on 6th October 1893, in a village in the district of Dacca (now in East Pakistan). He was the fifth child in a family of five sons and three daughters. The family was in a bad way financially, and Saha's early education was beset with many hardships. He passed the Entrance Examination in 1909 from Dacca standing first in East Bengal; and in 1911 he entered the Presidency College, Calcutta. Here he had amongst his contemporaries many who are now familiar names in Indian science, such as S. N. Bose, N. R. Sen, J. C. Ghosh and J. N. Mukherjee. P. C. Mahalanobis and N. R. Dhar were senior to Saha by a year or so. Here Saha learnt chemistry from P. C. Ray and physics from J. C. Bose. Saha took the M.Sc. Degree in applied mathematics (2nd in I Class) in 1915. He had at one time thought of competing for the Indian Finance Examination, but was not granted permission to appear because of his association with political revolutionaries like Jatindra Nath Mukherjee and Purlin Das in his college days. He now took up research in applied mathematics and physics. He was at one time doing as many as three private tuitions in different parts of Calcutta to support himself and his younger brother staying with him. However, these extreme difficulties did not continue for long as in 1916 Asutosh Mookerjee, the then Vice-Chancellor of the Calcutta University, started Post-Graduate Departments in Arts and Science directly under the University, and Saha was invited to join the Department of Mathematics as a Lecturer. His early lectures covered hydrostatics and the figure of the earth. (Dr. Ganesh Prasad was Professor of Mathematics at that time.) This was about the time when the World War I had shortly ended; and there was announced the momentous discovery of the deflection of light by the sun in accordance with the Einstein's theory of General

Relativity. Saha got deeply interested in relativity theory, and this and his study of quantum theory (and his fortunate contact with Agnes Clarke's book on astrophysics) soon led him to spectroscopy and astrophysics. He devoted the next four or five years to an intensive study of stellar spectra and allied problems. He formulated his theory of thermal ionization in his epoch-making paper entitled 'On Ionization in the Solar Atmosphere' which appeared in the *Philosophical Magazine* of 1920. It is pertinent to remark, as often statements have appeared to the contrary, that this paper was written while Saha was in Calcutta and was communicated to the *Philosophical Magazine* from Calcutta.

Saha was awarded the Premchand Roychand Scholarship of the Calcutta University in 1919 and he left for Europe in September 1919. He first went to U.K. and here he spent most of his time in the laboratory of the great spectroscopist Professor A. Fowler. He stayed for about five months in London and then went to Germany to work in Nernst's Laboratory where he stayed for about one year. Saha, during his stay abroad, came in contact with E. A. Milne, R. H. Fowler and C. G. Darwin who later made great contributions to Saha's ionization theory and its applications.

On return from England, Saha joined the University of Calcutta as Khaira Professor of Physics. In 1923 Saha was offered Professorship at the University of Allahabad which he accepted. The conditions of teaching and research in Allahabad were at that time quite different from what they were at Calcutta. In Calcutta largely due to the initiative and inspiring guidance of Asutosh Mookerjee systematic Post-Graduate teaching and research had already begun to make reasonable progress in the University. At Allahabad there was very little of advanced physics teaching: research was more or less unknown. Saha's great contribution at Allahabad was to lay the foundation of advanced teaching, and initiate and organise research in several fields such as thermal ionization, spectroscopy and wireless. It was in 1927 that Saha was elected to the Royal Society. As a recognition of this, the U.P. Government sanctioned a grant of Rs. 5,000 per annum for his research work. The Physics Department of the Allahabad University in the course of a decade became one of the most active research centres in the



country. Amongst his earliest associates in research, mention may be made of N. K. Sur, P. K. Kichlu and K. Majumdar. It was in association with Majumdar that Saha set up a high-temperature furnace and provided an experimental verification, though a somewhat crude one, of the formula of thermal ionization. Numerous papers appeared from the Allahabad School in atomic spectra, heats of dissociation, ionospheric studies, theories of radioactive decay and other subjects. It was while at Allahabad that Saha (jointly with B. N. Srivastava) published his world famous treatise on Heat which has now run into several editions. In 1925, Saha presided at the Physics Section of the Indian Science Congress. His address was on thermal ionization.

The scientific academies in India owe a large debt to Saha, for he played a vital role in creating an awareness in the country for the need of such academies and his role in founding them was of the utmost importance. The U.P. Academy of Science was founded in Allahabad in 1931. This was due almost entirely to Saha's efforts. Saha was unanimously elected the first President of the Academy. The Academy was renamed in 1934 as the National Academy of Sciences, India.

It is interesting to recall that one of the earliest symposia on national scientific problems was organised by the National Academy of Sciences in 1938. The subject was 'Power Supply'. Nehru presided on the occasion. Saha in opening the discussion observed: "The total output of work *per capita* per year in India is only 90 units, of which the major part is from manual labour, and only 7 units are from electrical power derived from coal, or running water, while in the advanced countries of the west, the total output is nearly 1,800 units, of which not more than 60 units are from manual labour, and the rest is all derived from forces of Nature." Later, in proposing a vote of thanks to the Chair, he said: "It was in the fitness of things that Pandit Jawaharlal has agreed to preside over this annual gathering of scientists in India. His position in the country can be described by a phrase which Americans use with respect to Abraham Lincoln: First in War, first in Peace, and next to Mahatma Gandhi, he occupies the first place in the hearts of his three hundred and fifty million countrymen. The time has now come for him to give a lead in peace-time work of reconstruction and consolidation of the country."

Saha was General President of the Science Congress at the 21st Session held in Bombay in 1934. In his Presidential Address he advo-

cated the formation of an Indian Academy of Sciences, and also for the establishment of a River Physics Laboratory for the study of flood and river utilisation problems. Saha's proposal led to the establishment of the National Institute of Sciences in India in 1935. Saha was elected President of the National Institute for the years 1937-39. In 1944, the Headquarters of the Institute were transferred from Calcutta to Delhi. At about the same time the Institute was recognised by the Government as the premier scientific society in the country and the Government provided funds to the Institute to enable it to function as such.

Saha visited Europe and America in 1936 as a Carnegie Trust Fellow. He visited the main centres of astrophysical research in Europe and the States. He attended the Tercentenary Celebrations of the Harvard University.

In 1938 Saha left Allahabad and joined the Calcutta University as Palit Professor in succession to C. V. Raman. Saha early realised the growing importance of nuclear physics, both as a subject of fundamental study and in its applications to natural progress. It is entirely due to him that the Institute of Nuclear Physics at Calcutta was founded in April 1948. The Institute is engaged in many problems such as beta-ray spectroscopy, nuclear resonance, and use of radioactive isotopes for medical purposes. It has also a cyclotron of pole diameter about 30 inches.

On his return to Calcutta, Saha began to take a keen interest in the activities of the Indian Association for the Cultivation of Science. He became the Secretary of the Association in 1944, and in 1946 he was elected President of the Association. The large-scale expansion that has taken place in the activities of the Association during the last decade is almost entirely due to Saha's initiative, enterprise and devoted work. The Association has now a new building in Jadavpur where it moved from Bowbazar in 1951.

Saha was succeeded by J. C. Ghosh to the Presidentship of the Association in 1950. Saha on his retirement from Palit Professorship of the Calcutta University, accepted the Directorship of the Indian Association for the Cultivation of Science.

The scientific work of Saha may be broadly divided under three heads: (i) astrophysics—this covers roughly the period 1918-25; (ii) spectroscopic and ionospheric studies—this covers roughly the period 1925-38; and (iii) nuclear physics—this covers the period 1938-55. The most creative years of Saha's scientific life belong to the first period. During these years he

devoted himself almost completely to astrophysics. In later years his interest became more widespread and a very large measure of his time and energy were taken up by teaching work and also other activities dealing with the impact of science on national life. The influence of Saha's teaching on the growth of physical research in the country can hardly be overestimated. Saha's greatest scientific work is his theory of thermal ionization and its applications to the spectra of stars. The great astronomer Otto Struve has observed: "His brilliant work on the ionization of stellar atmospheres, more than thirty years ago, resulted in a revolution in scientific thought comparable to that which occurred when Fraunhofer and Kirchhoff laid the foundations of the spectroscopic investigations of the celestial bodies. Saha's work has been a source of constant inspiration to virtually every astrophysicist during the present generation. My own early studies in stellar spectroscopy received an impetus from his work, and I believe that I have never written a scientific article in which I have not in one form or another made use of his theory of ionization."

Saha's work was the first effective step in linking the atom and the star together: The key to the understanding of stars lies in the understanding of atoms. If the fruitfulness of a theory is to be judged by its consequences, then Saha's work on thermal ionization must rank amongst the very greatest achievements

in the realm of modern physics. Much of the work in astrophysics during the last three decades has been dominated by Saha's theory and ideas. Apart from astrophysics, the theory has found numerous applications in ionospheric studies, flame conductivity and explosion reactions.

Saha was throughout his life an ardent nationalist. He took the keenest interest in problems of national planning, particularly in relation to science and technology. His numerous articles in *Science and Culture* bear witness to his wide interest, deep study and keen insight into these problems. His criticism was often provocative and trenchant, but it was motivated by deep patriotism and sincere, though often tenaciously held, convictions. During the years 1939-41, Saha did considerable work for the National Planning Committee which was organised by the Indian Science Congress under the Chairmanship of Jawaharlal Nehru.

Saha was married in June 1918 to Shrimati Radha Rani Saha—a lady who has been remarkable for her kindness, and her genuine simplicity and character. She has won the affection and respect of generations of students and colleagues of Saha. Saha is survived by his wife, three sons and three daughters. The eldest son, A. K. Saha, is Professor of Physics, Institute of Nuclear Physics, Calcutta.

D. S. KOTHARI.

## WORLD'S FIRST SOLAR ELECTRIC STATION

THE world's first solar electric station is soon to go into construction on the Ararat Plain in Armenia. This site has been chosen because it surpasses all other parts of the U.S.S.R. in duration and intensity of sunshine.

The solar station will be in the form of a circle of about three-quarters of a mile diameter bordered with trees to keep the mirrors free of dust. At the centre there will be a 130-foot tower. The tower will be rotated by means of a steam boiler whose water will be heated to boiling point by the sun, raising the steam pressure to 30 atmospheres. The steam produced at the rate of 11 tons per hour will then be piped to the turbine of a 1,200-kilowatt electric station.

Twenty-three circular railway tracks are to be built around the tower on which automatic trains will carry 1,293 large mirrors of total

area 215,000 square feet controlled automatically to face the sun and reflect the sun's rays on to the flat walls of the boiler. When the sun rises, its rays will fall on photocells which will switch on the automatic devices to set the trains and the other installations going.

The station will not only be used experimentally, but for industrial purposes as well. Its power will go to drain the subsoil waters from the lowlands and direct them to the fields. It is expected that tens of thousands of acres of land will be brought into cultivation by this means. It is planned to use the exhaust steam for heating hothouses and flats, and for hot-water supplies to baths and laundries.

The station was designed in the main by the USSR Academy of Sciences' Power Engineering Institute.

## XX INTERNATIONAL GEOLOGICAL CONGRESS, MEXICO D.F.

THE Twentieth Session of the International Geological Congress was held at Mexico D.F. from 4th to 11th September 1956, under the Presidentship of Dr. A. Garcia Rojas. El Senor don Adolfo Ruiz Cortines, President of the Republic of Mexico, opened the session in the National Auditorium of Mexico. Geologists from over eighty countries numbering nearly four thousand participated in the proceedings. The General Assembly divided itself into sixteen sections, each of them dealing with a specific aspect, namely, Cenozoic volcanology, correlation of the Mesozoics of the world, petroleum geology, hydrogeology, relation of tectonics to sedimentation, modern ideas on the origin of metallic and non-metallic minerals, palaeontology and evolution, plutonic rocks—their origin and relation to tectonics, geophysical applications, micropalaeontology, geochemistry, exploration geochemistry, isotope geology, geology as applied to engineering and mineral development, marine and submarine geology, petrology and mineralogy and diverse problems in general geology.

Besides these, full-fledged symposia were held on petroleum and natural gas, origin of manganese, the cretaceous correlation, geochemical exploration, palaeogeography of the Cambrian system on Gondwanas. Several commissions met during the session, the most important of which was perhaps, the one on the geological map of the world. All the scientific meetings were held in the newly-built fabulous university city of Mexico, where massive buildings on a beautifully laid out campus with gigantic inlaid Mexican murals decorating the outer walls presented an imposing spectacle. Besides the large contingent from the United States, some of the countries like Russia, France, Canada, Great Britain and colonies were strongly represented by eminent geologists.

A number of papers of fundamental importance in the sessional meetings and symposia afforded a forum for discussion; perhaps equally important were the informal discussions between the delegates outside the actual session. A variety of sound films depicting the scientific studies and progress on the geological and allied fields provided an instructive attraction. The difficulty felt by most of the delegates was the too heavy programme making it obligatory for them to limit their interests to a few sections only. The Mexican Government lavished money and made perfect arrangements for the convenience and comfort of the delegates and everyone shared the feeling that the organisation of the session was a big job done in a

big way. The delegates were treated to Mexican folk dances on the night of 5th September in one of the most modern and beautiful theatres—The National Auditorium of Mexico. Some of the dances of the Mexican Indians showed strong affinity to folk dances in India. The display of horsemanship by gentlemen and ladies, girls and boys in the Mexican arena of The National Horse Club on Sunday, the 8th September, was very much appreciated.

Mexico is one of the leading countries in the production of such minerals as silver, lead, zinc and copper as well as petroleum. The geology of this region, which is a classical ground for the study of volcanism and ore deposition, affords extensive attraction for field observations. A large number of excursions to the different mining districts were organised before and after the Congress, and excellent guides and guide books were provided to those participating in these. There was a universal feeling that these excursions were as valuable to visiting geologists as the session itself.

The Indian Delegation consisted of Dr. M. S. Krishnan, Joint Secretary, Ministry of Natural Resources and Scientific Research, Government of India, Prof. C. Mahadevan, Head of the Departments of Geology and Geophysics, Andhra University, Waltair, and Mr. V. P. Sondhi, Director, Geological Survey of India, Calcutta; besides, Dr. K. P. Rode from Rajputana University, and Mr. B. B. Engineer, from Tata Iron and Steel Company, and Dr. M. Poornachandra Rao, of Andhra University (now working at the Scripps' Institute of Oceanography in Point-Four Programme of U.S.A.) also attended the session. A number of papers on the manganese deposits of India were presented by Mr. V. P. Sondhi and other officers from the Geological Survey of India, by Mr. B. B. Engineer of Tata Iron and Steel Company, and Prof. C. Mahadevan. Other papers from India were on geochemical prospecting by the officers of the Geological Survey of India; Gondwana correlation, hydrogeology and marine geology, by Prof. Mahadevan and his collaborators in the Andhra University. Dr. K. P. Rode expounded his new theory of 'Geo-kinematic' evolution in one of the meetings.

Unfortunately, the cable from the Government of India inviting the next session of the Geological Congress to India was received too late, only after the Council had accepted the provisional invitation of the Scandinavian countries headed by Norway. Among the delegates there was a general regret that India was not to be the next venue.

# THE GENUS *SPIROCLYPEUS* FROM KUTCH, WESTERN INDIA

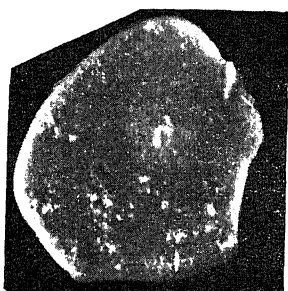
B. S. TEWARI

Dept. of Geology, Lucknow University, Lucknow

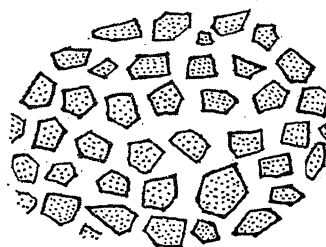
THE foraminiferal genus *Spiroclypeus*, largely employed in the correlation of the Lower Tertiary strata of Indo-Pacific region by Douvillé,<sup>1</sup> Vlerk,<sup>2,3</sup> Nuttall,<sup>4</sup> Vlerk and Umbgrove,<sup>5</sup> Krijnen,<sup>6</sup> Leupold and Vlerk,<sup>7</sup> Tan Sin Hok<sup>8</sup> and Rutten<sup>9</sup> is being reported from Waior (N. 23° 25' : E. 68° 44'), Kutch, Western India. This is the first report of the genus from this country.

*clypeus pleurocentralis* (Carter) from Arabia to the same genus. Subsequently, he referred *S. pleurocentralis* from the village Takah, South-Eastern Arabia, to the genera *Orbiculina* and *Heterostegina*. However, Douvillé described *S. pleurocentralis* from the Miocene beds of Borneo and brought the above under the synonymy of the same.

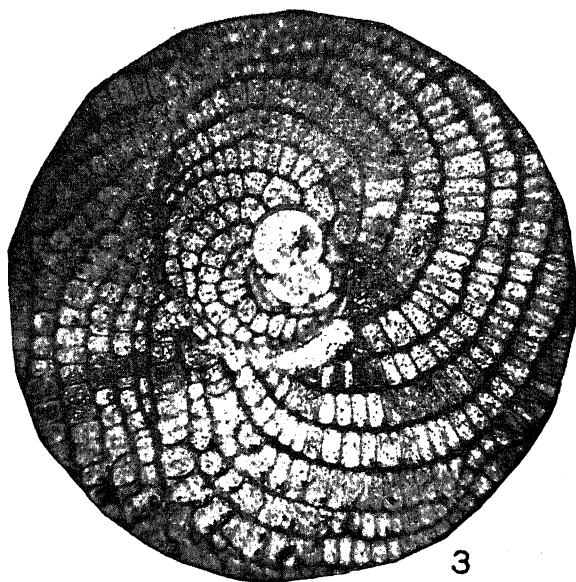
Many specimens of *Spiroclypeus ranjanæ* sp.



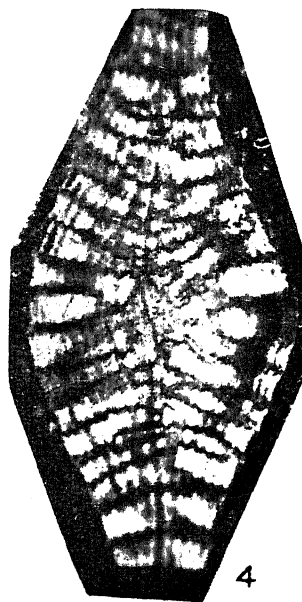
1



2



3



4

FIGS. 1-4. *Spiroclypeus ranjanæ* sp. nov.

1. External view,  $\times 10$ .
2. Pattern of reticulation on the external surface,  $\times 42$ .
3. Equatorial section, Form (A), showing bilocular nucleococonch, spiral lamina and chamberlets, etc.,  $\times 45$ .
4. Axial section,  $\times 45$ .

Carter<sup>10</sup> reported *Lycorhphris dispansa* (*Discocyclina dispansa*) from Sind, Kutch and Arabia, and later erroneously referred *Spiro-*

*nov.*, described here, were isolated from a compact yellowish white limestone outcropping at a distance of about 2 furlongs north-east of

the village Waior. The bed which is a part of the Arenaceous Group of Wynne<sup>11</sup> is about 15 feet thick and dips at a low angle of 3° to 5° towards south. It overlies a horizon, containing *Nummulites intermedius*, *N. clipeus*, *N. subclipeus* and *N. fichteli*, which is of Oligocene age (Nari Series) and is overlain, with a small break, by Lower Miocene beds (Gaj Series) from which *Miogypsina irregularis*, *Austrotrillina howchini*, *Lepidocyclina* (*Nephrolepidina*) *sumatrensis*, L. (N.) *borneensis*, *Miogypsinoides dehaarti*, *Operculina* sp., *Spiroclypeus* sp., *Hypoprion* sp., *Ostrea angulata*, *Archæolithothamnion*, *Lithothamnion*, and *Corallina* have been identified. This assemblage resembles somewhat the fauna of the lowest part of Bed No. 4 of Vinhan-Miani area.<sup>12</sup> *Spiroclypeus ranjanæ* sp. nov. is found associated with *Schizaster granti*, *Gypsina globulus*, *Rotalia*, *Eponides*, *Operculina* together with occasional *Nephrolepidina* and *Miogypsina* s.l. Neither *Eulepidina* nor reticulate *Nummulites* are present. The presence of *Miogypsina* s.l. along with *Spiroclypeus*<sup>13,14</sup> indicates Aquitanian (basal part of Lower Miocene) age for this horizon.

#### DESCRIPTION OF *Spiroclypeus ranjanæ* SP. NOV.

The species has a flat test, occasionally undulating and roughly pentagonal in outline with a mamelon. The thickest portion of the test is a little away from the centre and the surface is covered with polygonal areas together with pillars at and round the mamelon. The diameter of the test varies from about 4 mm. to 7 mm. and maximum thickness from about 1.0 mm. to 1.4 mm. The ratio of thickness of the test varies from 1:3.5 to 1:4.5. The edge of the test is rounded and it belongs to the reticulate group—reticulation measuring 60  $\mu$  to 160  $\mu$ . All the specimens examined are megalospheric.

In equatorial section the initial chamber is 332  $\mu$  to 420  $\mu$  in diameter and is partly surrounded by a kidney-shaped second chamber measuring 364  $\mu$  to 392  $\mu$ . Length across both is 500  $\mu$  to 520  $\mu$  with a thick wall, varying from 8  $\mu$  to 40  $\mu$  round them. The coils rapidly increase in breadth. The whorls are divided into primary chambers by curved-septa which make an angle of about 20° with the spiral lamina. The curved-septa are 20  $\mu$  to 28  $\mu$  in thickness while the radial-septa are 8  $\mu$  to 16  $\mu$  thick. The primary chambers are divided into rectangular chamberlets whose maximum length and width are 200  $\mu$  and 120  $\mu$  respectively.

In axial section the equatorial layer is about 40  $\mu$  thick near the centre without walls which are also about 40  $\mu$ . This thins away a little towards the periphery. The lateral chambers are well marked and are 160  $\mu$  in length and 16  $\mu$  in height near the surface at the mamelon. The walls of the lateral chambers are 20  $\mu$  to 28  $\mu$  thick. There are pillars running between the tiers of the lateral chambers and measure 60  $\mu$  to 90  $\mu$  in diameter. There are 10 to 12 tiers of lateral chambers on both sides of the equatorial layers.

**Remarks.**—*Spiroclypeus ranjanæ* resembles somewhat in vertical sections *S. orbitoides* Douvillé but differs from the latter in its smaller size and thicker walls of the lateral chambers. *S. leupoldi* Vlerk, a pustulate form, cannot be identified with the present form due to its more globose shape, in larger lateral chambers in axial sections and other differences in internal measurements. *S. margaritatus* (Schlumberger) and *S. tidaenganensis* Vlerk are species of the pustulate group and also differ from the present species in measurements.

I have named this species in memory of my daughter, Ranjana (who is no more), who had been the greatest source of inspiration to me in my work. I am grateful to Dr. M. F. Glaessner of the University of Adelaide, Australia, for confirming my identification and making valuable suggestions.

The work has been carried out in the scheme sponsored by the Scientific Research Committee, U.P., Allahabad.

1. Douvillé, H., *Bull. Soc. Geol. France*, 1905, 5, Ser. 4, 435.
2. Vlerk, I. M. Vander, *Wetensch. Meded.*, 1925, 3, *Dienst. v.d. Mijnbouw*, 13.
3. —, *Meeting Intern. Palaont. Union, Sec. III*, London, 1948.
4. Nuttall, W. L. F., *Quart. J. Geol. Soc.*, London, 1926, 82, 36.
5. Vlerk, I. M. Vander and Umbgrove, J. H. F., *Wetensch. Meded.*, 1927, 6, *Dienst. v.d. Mijnbouw*.
6. Krijnen, W. F., *Verhand. Geol. Mijnb. Gen. (Geol. Serie)*, 1931, 9, 77.
7. Leupold, and Vlerk, I. M. Vander, *Leidsche Geol. Meded.*, 1931, 5, 611.
8. Tan Sin Hok, *Ing. Ned. Indie (IV)*, *Mijnbouw en Geologie*, 1937, 10, 177.
9. Rutten, M. G., *Geogr. and Geol. Med. Univ. Utrecht. Phys.-geol. reeks*, Series II, 1947, 9.
10. Carter, H. J., *Geol. Papers on West India*, 1857, 55, 593.
11. Wynne, A. B., *Mem. Geol. Surv. Ind.*, 1872, 9, 78.
12. Tewari, B. S., *Curr. Sci.*, 1952, 21, 217.
13. Glaessner, M. F., *Geol. Mag.*, 1951, 88, 282.
14. Eames, F. E., *Ibid.*, 1953, 90, 391.

## PHYSIOLOGY OF HIBERNATION OF THE APPLE-SNAIL *PILA VIRENS* (LAMARCK)

(MISS) V. R. MEENAKSHI\*

Dept. of Zoology, Annamalai University, Annamalainagar

THE bulk of research in the physiology of hibernation, as pointed out by Gorer,<sup>1</sup> has been on animals in cold countries and mostly on mammals. Regarding the factors that govern and co-ordinate the several metabolic changes involved in hibernation little is known at present.

The South Indian apple-snail, which has an amphibious mode of respiration, is well known for its remarkable powers of aestivation which may extend for two years or even longer. For experimental investigation, specimens of *Pila* were kept completely embedded air-tight in 'plastimould' for over six months, after which period they could be revived. The investigations on *Pila* show that its aestivation involves anaerobic metabolism and that the factors governing aestivation can be traced to biochemical changes in the cerebral ganglia of the animal.

In the study of anaerobic metabolism, the lactic acid content was determined by the method of Barker and Summerson<sup>2</sup> and glycogen by the method recommended by Good, Krammer and Somogyi.<sup>3</sup> For the study of post-aestivation metabolism the animals were revived in water and the oxygen consumption determined by the standard Winkler's method.<sup>4</sup>

The free and protein-bound amino acids in the brain were studied by the circular paper chromatographic method of Giri *et al.*<sup>5</sup> and the non-saponifiable fraction of the ether extract of the brain was tested for sterols by the Salkowski colour test.<sup>6</sup> The magnesium and calcium of the blood were determined by the modified method of Denis and the Clark Collop modification of the Krammer Tasdall method given by Hawk *et al.*<sup>7</sup>

In animals which had been aestivating for six months the following biochemical features were observed in comparison with normal animals:—(1) accumulation of lactic acid (as lactate) in the tissues to about 40-50 mg. per animal; (2) fall in glycogen content by 80-85 mg.; (3) rise of magnesium content of the blood from the normal level of 3.5 mg. to 6 mg./100 ml. of blood and increased calcium level from 19.5 to 30 mg./100 ml. blood; (4) increase of glutamic acid concentration as a free amino acid in the cerebral ganglia to twice the nor-

mal concentration, as determined colorimetrically, and also an increase of asparagine (Fig. 1); (5) an increase to about ten times

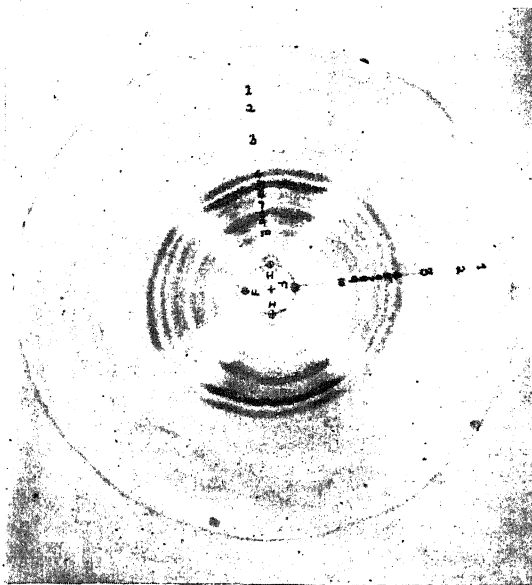


FIG. 1. Chromatogram showing the greater concentration of the free amino acids, glutamic acid (5) and asparagine (8) in the hibernating animal (H) compared with those of the active animal (F). The amino acids were identified by spotting the known and unknown in mixed chromatograms.

of the relative concentration of the non-saponifiable fraction in the ether extract of the cerebral ganglia: when tested for sterols this non-saponifiable fraction gave the *reverse* Salkowsky reaction,<sup>6</sup> indicating the presence of non-cholesterol type of sterols; and (6) the pH of the blood is unaltered, being about 7.3 as in the normal animals.

Specimens of *Pila* which were experimentally kept in water under anoxic conditions (in water boiled and cooled out of contact with water, and with a layer of liquid paraffin on the surface), the following features were observed:—(1) an alteration of the pH of the blood to 4.5; (2) an increase in lactic acid accumulation to about thirty times as compared with that of aestivating animals; and (3) the absence of any change in the calcium and magnesium

\* Present Address: Dept. of Zoology, Alagappa College for Women, Karaikudi.

content of the blood as compared with that of normal animal.

These anoxic animals do not survive anaerobic life for more than two or three days. According to Slater,<sup>8</sup> the period of anaerobic life in animals should be limited, and this is what we see in the anoxic animals. But in aestivation, the anaerobic glycolysis is regulated and can last for a shorter or longer period in response to environmental factors.

The post-aestivation metabolism, as experiments show,<sup>9</sup> is characterised by 'payment of oxygen debt' and disappearance of lactic acid, as in typical anaerobiosis.

To find out the significance of the rise of magnesium in the blood, an aqueous solution of  $MgCl_2$  (3 mg./100 ml.) was injected into normal active animals. This resulted in the lowering of oxygen consumption and lowering of metabolism as indicated by the incomplete 'payment of oxygen debt' during the recovery period.

A rise in the magnesium content of the blood has been observed in the hedgehog<sup>10</sup> and bat<sup>11</sup> during hibernation but there is no rise in calcium in these animals. In the hedgehog and bat there is no anaerobic glycolysis but the aestivation of *Pila* definitely involves anaerobic glycolysis. Calcium neutralises the lactic acid, and the calcium lactate, according to my investigation,<sup>9</sup> is stored in the foot. The pH of the blood of the aestivating *Pila* is unaltered due to this buffering action. *Pila* can aestivate with its anaerobic glycolysis as long as its lactic acid is neutralised by calcium.

Injection of the sterol fraction of the ether extract of the cerebral ganglia of hibernating

animals into an active animal produces the following changes:—(1) increase of magnesium content of blood; (2) increase of calcium content of blood; and (3) lowering of oxygen consumption. Injection of glutamic acid and asparagine into the active animal does not produce any change. There is therefore convincing evidence that the ten-fold increase in the sterol concentration in the brain is a governing factor for the rise of magnesium and calcium, which in their turn are regulating factors for other features in aestivation metabolism. The main controlling factor in the aestivation of *Pila* is evidently a sterol type of hormone produced in the cerebral ganglia. It must be added that suitable controls were set up in all the experiments. Further work is in progress.

My thanks are due to Prof. R. V. Seshaiya for suggesting this line of work and for guidance and instruction, and to the Government of India for the award of a scholarship.

1. Gorer, P. A., *Biol. Rev.*, 1930, **5**, 213.
2. Barker, S. B. and Summerson, W., *J. Biol. Chem.*, 1941, **138**, 535.
3. Good *et al.*, *Ibid.*, 1933, **100**, 485.
4. Theroux, F. R. *et al.*, *Analysis of Water and Sewage*, 1943, McGraw-Hill Book Co., N.Y.
5. Giri *et al.*, *Curr. Sci.*, 1952, **21**, 44.
6. Rangaswamy and Seshadri, *Vitamins and Hormones*, 1952, Andhra Univ. Publication.
7. Hawk *et al.*, *Practical Physiological Chemistry*, 1947, J. A. Churchill, Ltd.
8. Slater, W. K., *Biol. Rev.*, 1928, **3**, 303.
9. Meenakshi, V. R., 1956, Unpublished work.
10. Suomalainen, P., *Nature*, 1938, **141**, 471.
11. Riedesel, M. L. and Edgar, G., *Ibid.*, 1956, **177**, 668.

## CHROMOSOME NUMBER OF MAN

IT has generally been believed that the somatic cell of man contains 48 chromosomes; but Drs. J. H. Tjio and L. Levan have suggested that the number should be 46, and in support Dr. Tjio showed preparations of human chromosomes at the Congress of Human Genetics held during August 1-6 at Copenhagen. Tissue cultures of fibroblasts from human embryonic lung were treated with colchicine to effect an accumulation of mitoses. Before fixation they were treated for one or two minutes with hypotonic saline solution, a method which had been used before by T. C. Hsu to induce scattering of the chromosomes. Fixation followed in 60% acetic acid twice exchanged to wash out the salts left from the culture medium and the

hypotonic saline that would otherwise have caused precipitation with orcein. Ordinary squash preparations were then made in 1% acetic orcein. Single cells were squashed under microscopical observation by slight pressure with a needle, and it was seen that no chromosomes escaped. On 22 cultures, 261 chromosome counts were made, and the chromosome number was found to be 46 ( $2n=46$ ).

During the Congress, Drs. C. E. Ford and J. L. Hamerton, of Harwell, England, also showed photomicrographs of cells from three human testes confirming that the true number was 46 and estimating that the total length of the human chromosomes was 27 morgan units, half as long again as those of the mouse.

## LETTERS TO THE EDITOR

	PAGE		PAGE
Unit Cell and Space Group of Cheralite— P. G. KHUBCHANDANI .. ..	323	Tiny Seed and Tiny Pod Segregates in Bengal Gram ( <i>Cicer arietinum</i> )—B. B. CHAUDHARI .. ..	330
Corona Theorem for Air Under Low Fre- quency Discharge Using a Maze Counter —D. P. JATAR AND H. D. SHARMA ..	324	Some Mycophagous Insects and Their Parasites Associated with Sugarcane— R. A. AGARWAL .. ..	332
Chemical Investigation of <i>Cocculus hirsu-</i> <i>tus</i> (Linn.) Diels.—R. M. NAIK AND J. R. MERCHANT .. ..	324	A New Mutation in <i>Cajanus cajan</i> Millsp. —N. B. KAJJARI .. ..	333
Characterization of the Pigment in Red Tamarind ( <i>Tamarindus indica</i> , Linn.)— Y. S. LEWIS AND D. S. JOHAR ..	325	A Synthesis of 4-Acetomethyl-Coumarin Derivatives—J. L. BOSE AND R. C. SHAH	333
Some Observations on Tetralone Chemis- try—P. S. RAMAN .. ..	326	A Record of <i>Globidium leuckarti</i> (Flesch) from a Horse in India—L. S. HIREGAUDAR	334
Lipochromes of <i>Gyrostoma</i> sp. (Sea <i>Anemones</i> )—M. V. RAJAGOPAL AND KAMALA SOHONIE .. ..	327	On Forecasting Heavy Rainfall in Malabar, South Kanara and Travan- core-Cochin during June and July— K. L. SINHA .. ..	335
Vitexin from <i>Vitex peduncularis</i> Wall— CH. BHEEMASANKARA RAO AND V. VENKA- TESWARLU .. ..	328	Synthesis of Vinylogues of $\beta$ -Di and $\beta$ - Triketones—V. S. GAIND AND S. M. MUKHERJI .. ..	336
Adsorption of Carbon Monoxide by Nickel: Formation of Nickel Carbonyl— V. SRINIVASAN AND K. R. KRISHNASWAMY	328	5:7 Dibromo-8-Quinolinol Complex of Molybdenum—D. V. RAMANA RAO ..	337
Detection of Growth Factors in Culture Fil- trates of <i>Fusaria</i> —C. S. VENKATA RAM	329	Earlier Record of <i>Phalacrus immarginatus</i> Champion (Coleoptera, Phalacridæ)— R. N. MATHUR .. ..	337
Bacterial Red Stripe Disease of Sugarcane Caused by <i>Xanthomonas rubrilineans</i> in Bombay State—V. P. BHIDE, R. K. HEGDE AND M. K. DESAI .. ..	330	On the Viscosity of Solutions in Mixed Solvents—D. PATNAIK AND P. K. DAS	337

UNIT CELL AND SPACE GROUP  
OF CHERALITE

CHERALITE found in Travancore-Cochin State is a mineral of the monazite group. Wadia<sup>1</sup> reports variants containing 4-6%  $U_3O_8$  and 19-33%  $ThO_2$ . It has been described by Bowie and Horne.<sup>2</sup> These authors carried out X-ray powder study of the mineral and obtained the cell parameters.

Using a small fragment from a sample (supplied by the Raw Materials Division) which did not show any clear-cut faces, single crystal rotation and Weissenberg photographs have been taken. These show sharp and well-defined layer lines from which the following parameters (Table I) have been obtained.

From the indices of the systematic absences observed on these photographs, the space group was found to be  $P2_1/n$ .

TABLE I

	Values obtained here	Values by Bowie and Horne
<i>a</i>	6.70	6.74
<i>b</i>	6.87	7.00
<i>c</i>	6.39	6.43
$\beta$	103° 24'	104° 6'

Chemistry Division, P. G. KHUBCHANDANI.  
Atomic Energy Establishment,  
Bombay, July 16, 1956.

1. Wadia, D. N.. "Holland Memorial Lecture," *Sci. & Cult.*, 1956, 21, 561.
2. Bowie, S. H. U. and Horne, J. E. T., *Min. Mag.*, 1953, 30, 93.



# CORONA THEOREM FOR AIR UNDER LOW FREQUENCY DISCHARGE USING A MAZE COUNTER

A DIRECT comparison of the breakdown potentials for corona discharges between coaxial cylinders in a gas is not possible for tubes of different electrode diameters. A comparison can, however, be made between the threshold potentials,  $V_1$  and  $V_2$ , for two wire-in-cylinder type discharge tubes of the same wire radius,  $r$ , but with cylinders of different radii,  $R_1$  and  $R_2$ , by applying the corona theorem<sup>1</sup>

$$\frac{V_1}{V_2} = \frac{\log (R_1/r)}{\log (R_2/r)}$$

For discharges using metal electrodes, this method has been used by a number of workers<sup>1-3</sup> and the theorem has been established under conditions where the coefficients of ionization are negligible at points remote from the central electrode and space charges do not influence the breakdown. The present note describes the results obtained for the low frequency (50 c/s.) discharge in air using a Maze counter.

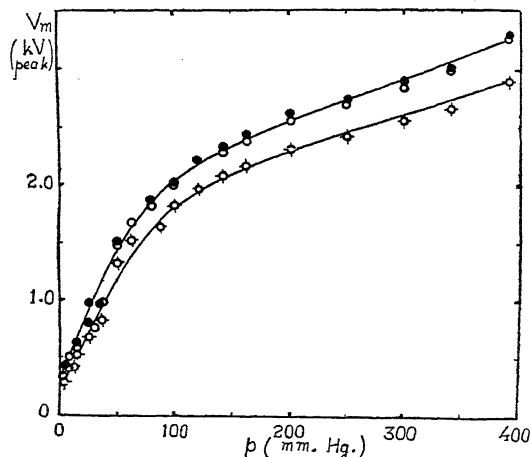


FIG. 1. Corona theorem for air using Maze counters. Lower curve breakdown potential for tube 1. Upper curve breakdown potential for tube 2. Experimental values are indicated by circles and calculated values by dots.

The general experimental arrangement was the same as that employed earlier.<sup>4</sup> Atmospheric air dried over  $P_2O_5$  was used. The discharge tubes were essentially Maze counters with the central copper wire of diameter,  $2r = 0.05$  cm. and outer glass cylinders of outer diameters,  $2R$  in the range from 0.69 cm. to 2.63 cm. The breakdown potential,  $V_m$ , was indicated by (i) a sudden rise in the current flowing through the tube, (ii) the initiation of

a glow, and (iii) the appearance of h.f. pulses on the current oscillogram. Typical values of the breakdown potential for only two tubes of  $2R = 1.41$  cm. and 0.94 cm. are shown in Fig. 1. Values of  $V_2$  ( $V_m$  for tube 2) calculated from values of  $V_1$  ( $V_m$  for tube 1) using the corona theorem are also shown in Fig. 1. The close agreement between the calculated and the experimentally observed values clearly indicates that the corona theorem holds good for this type of discharge also. The results obtained for all glass ozonizers of the Siemens type are essentially similar.<sup>5</sup> Details will be published elsewhere.

Dept. of Physics,  
Saugar University,  
August 2, 1956.

D. P. JATAR.  
H. D. SHARMA.

1. Jones, F. Llewellyn and Williams, G. C., *Proc. Phys. Soc. (Lond.)*, 1953, **66 B**, 345.
2. Townsend, J. S. and Edmunds, P. J., *Phil. Mag.*, 1914, **27**, 789.
3. Craggs, J. D. and Meek, J. M., *Proc. Phys. Soc. (Lond.)*, 1948, **61**, 327.
4. Jatar, D. P. and Sharma, H. D., *Saugar Univ. J.*, 1956, **1** (5), 103.
5. — (Unpublished).

## CHEMICAL INVESTIGATION OF COCCULUS HIRSUTUS (LINN.) DIELS.

*Cocculus hirsutus* belongs to the natural order Menispermaceæ and is used in the Indian system of medicine for chronic rheumatism, fevers and digestive disorders.<sup>1</sup> The chemical investigation of the plant was therefore undertaken with a view to determine the active constituents.

The petroleum ether extract of the whole plant after chromatographic separation over alumina, gave the following substances: (i) A neutral white substance of m.p. 84–85° (Found: C, 81.7%; H, 14.1%; 'H', 0.23%;  $-OCH_3$ , nil). Its acetyl derivative had m.p. 47–48° (Found: C, 79.6%; H, 13.2%). (ii) A colourless solid of m.p. 143–144°, which gave a positive Liebermann-Burchard test for sterols and was identified as  $\beta$ -sitosterol by a mixed m.p. determination (Found: C, 83.6%; H, 11.9%; 'H' 0.33%;  $C_{20}H_{30}O$  requires: C, 84.0%; H, 12.2%; 'H', 0.24%). Its acetyl derivative had m.p. 131–132° (Found: C, 81.3%; H, 11.8%;  $C_{31}H_{52}O_2$  requires: C, 81.6%; H, 11.4%). (iii) A colourless neutral substance of m.p. 104° (Found: C, 77.5%; H, 13.6%). In addition to the above solids, an appreciable quantity of a viscous oil was also obtained.

From the methanol extract of the whole plant, two substances were isolated: (i) a

nitrogen-free crystalline solid of m.p. 224-225°. It was soluble in hot water but insoluble in most organic solvents. It did not reduce Fehling's solution but gave a silver mirror test with ammoniacal silver nitrate, (ii) a small amount of a pale yellow substance having m.p. 119-120°.

The petroleum ether extract of the roots gave a large quantity of a brownish oil and a sterol of m.p. 156-57° (Found: C, 80.0%; H, 11.9%). The methanol extract of the roots gave positive tests for alkaloids and also reduced Fehling's solution. A 1% hydrochloric acid extract of the plant gave an alkaloidal base from which two picrates of m.p. 204-205° and m.p. 211° were obtained.

A fuller account will be published elsewhere.

Dept. of Organic Chemistry, R. M. NAIK.  
Institute of Science, J. R. MERCHANT.  
Bombay-1, July 15, 1956.

I. Nadkarni, A. K., *Indian Materia Medica*, Popular Book Depot and Dhoot-papeshwar Prakashan Ltd., Bombay, 1954, 1, p. 362.

#### CHARACTERIZATION OF THE PIGMENT IN RED TAMARIND (*TAMARINDUS INDICA*, LINN.)

DURING our investigations on the chemistry of tamarinds<sup>1,2</sup> (*Tamarindus indica*, Linn.), we have come across a little-known variety of the tree which yields berries with flesh of a rose-red colour instead of the usual light-green colour. The berries from such trees are reputed to be 'sweet' compared to the very sour ones from the commoner variety. This, from our preliminary investigations, seems to be due to a very large part of the tartaric acid of the fruit (10-12%) being present in combined form as potassium bitartrate in the red variety as compared to the commoner variety where a large part of the acid is in free form.

The water-soluble rose-red pigment is an anthocyanin, probably identical with chrysanthemin, as can be seen from the following evidence.

The pigment was isolated from the juice by extraction with *n*-butanol and precipitation with ether, etc., according to the procedure used by Kertesz.<sup>3</sup>

The unknown anthocyanin was chromatographed together with cyanin (for reference) from red roses using butanol/acetic acid/water as solvent. The  $R_f$  values were 0.32 and 0.17 respectively. Only one spot was given by the unknown. From the table given by Bate-Smith<sup>4</sup>

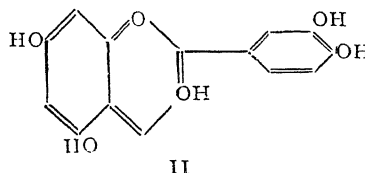
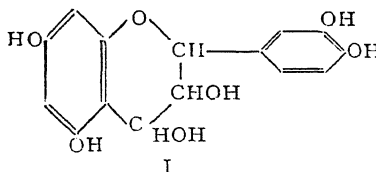
the former value suggests chrysanthemin or pelargonin.

The aglucones of the pigment and of cyanin were prepared by hydrolysis with 5N hydrochloric acid. These were chromatographed on paper, using the 'Forestal solvent'<sup>5</sup> (water/acetic acid/con. hydrochloric acid).

The  $R_f$  value for both was the same, viz., 0.50. Absorption maxima of the anthocyanidins in ethanolic HCl solution were also identical (545 m $\mu$ ). This agrees with values given by Bate-Smith for cyanidin.

The sugar moiety in the pigment was identified by neutralising the clear supernatant liquid after acid hydrolysis, concentrating and chromatographing with a reference mixture, using butanol/acetic acid/water as solvent. Only one strong spot corresponding to glucose was obtained. The osazone prepared from the concentrate had the crystalline form of glucosazone. Further, addition of sodium carbonate to the solution of the unknown pigment produced a blue colour, identical with that given by a crimson carnation extract (known to contain chrysanthemin). Chromatographically also, there was a marked similarity in the behaviour of the two pigments.

The tissue of green tamarind berry when boiled with dilute hydrochloric acid, gave a red colour, indicating the presence of a colourless precursor, a leuco-anthocyanin.<sup>5</sup> The red pigment released was chromatographically identified as cyanidin. The leuco-base is soluble in water, but cannot be extracted from aqueous solution by ethyl acetate, which indicate its glycosidic nature.<sup>6</sup> It is precipitated by hide powder, is astringent in taste and gives a strong Vanillin reaction. Being a flavan-3-4 diol (I) in nature<sup>7</sup> the colourless leuco-cyanidin of green tamarind is thus more closely related to the catechins and condensed tannins<sup>8</sup> than the anthocyanin pigment of red tamarind which is a polyhydroxy-2-phenyl benzopyrylium compound (II).



Grateful thanks are due to the Curator, Lal-bagh Gardens, Bangalore, for the samples of red tamarind and flowers.

Central Food Tech.

Y. S. LEWIS.

Res. Institute, Mysore,

D. S. JOHAR.

June 20, 1956.

1. Lewis, Y. S. and Johar, D. S., *J. Sci. Industr. Res.*, 1954, **13A** (6), 284.
2. —, *Ibid.*, 1954, **13B** (11), 815.
3. Sondheimer, E. and Kertesz, Z. I., *J. Amer. Chem. Soc.*, 1948, **70**, 3476.
4. Bate-Smith, E. C., *Biochem. Soc. Symp.*, 1951, No. 3, p. 62.
5. —, *Biochem. J.*, 1954, **58**, 122.
6. Robinson, G. M. and Robinson, R., *J. Chem. Soc.*, 1935, 744.
7. Roberts, E. A. H., Cartwright, R. A. and Wood, D. J., *J. Sci. Fd. Agric.*, 1956, **7**, 254.
8. Bate-Smith, E. C. and Swain, T., *Chem. and Ind.*, 1953, 377.

### SOME OBSERVATIONS ON TETRALONE CHEMISTRY

WHILE investigating possible routes to synthesise condensed heterocyclic ring systems, it was suggested by Dr. K. N. Menon that 4-keto-1, 2, 3, 4-tetrahydro-2-naphthoic acid<sup>1</sup> may be made the starting point. The methyl ester of the acid gave the amide on shaking with ammonia, and the hydrazide hydrazone by treatment with hydrazine hydrate. The oxime of the methyl ester gave the oxime hydrazide. The Hofmann degradation of the amide and the Curtius degradation of the hydrazide did not proceed normally, but the latter gave interesting results. The hydrazide was treated in the usual way with nitrous acid, then with ethanol followed by hydrolysis with mineral acid. The only product that could be isolated was  $\alpha$ -naphthol. The degradation of the oxime hydrazide also gave the same result. This result is of interest in conjunction with reports of such aromatisation recorded in the paper on the synthesis of lysergic acid.<sup>2</sup>

Having failed to obtain the desired 2-amino-4-tetralone, attention was directed to the synthesis of 3-amino-4-tetralone.  $\alpha$ -Tetralone oxime afforded the *p*-toluenesulphonic ester in alkaline medium. The Neber rearrangement<sup>3</sup> of this ester gave the amino ketone in rather poor yield. Worse still the free base proved to be too unstable to be useful and thus parallels the instability of 4-amino-1-benzoyl-5-keto-1, 2, 2a, 3, 4, 5-hexahydrobenz (cd) indole.<sup>2</sup>

**Tetralone - 3 - carboxamide.**—3-Carbomethoxy tetralone was prepared by esterifying the acid

with methyl alcoholic sulphuric acid. The ester (6 g.) was shaken with liquor ammonia (30 ml.). After 2 hr. the amide separated and after shaking for another hour the mixture was diluted with water and the amide collected. It crystallised in pale yellow plates from water, m.p. 183° to 184°, yield 4 g. (Found: C, 70.0 and H, 6.0. Calculated for  $C_{11}H_{11}O_2N$ : C, 69.8, H, 5.8.)

**Oxime hydrazide of the ester.**—The oxime of the keto-ester was readily obtained in theoretical yield by heating for 5 hr. on a water-bath the ester (2.5 g.) and hydroxylamine hydrochloride (1.2 g.) in pyridine (15 ml.). The oxime (2 g.) was refluxed for 4 hr. in absolute ethanol (20 ml.) containing hydrazine hydrate (10 ml.). The product obtained on dilution crystallised from ethanol in fine needles, m.p. 203°. It was soluble in acids and alkalis. (Found: C, 60.0, H, 6.2. Calculated for  $C_{11}H_{13}O_2N_3$ : C, 60.3, H, 5.9.)

The oxime hydrazide (0.5 g.) was dissolved in 10% hydrochloric acid (20 ml.) and treated with a slight excess of sodium nitrite solution under ice cooling. The solid that separated was collected and pressed free of water (m.p. 75-77° dec.). This was refluxed with absolute ethanol (10 ml.) for 3 hr., cooled, diluted with water and ether extracted. The ether extract afforded a liquid product and this was refluxed with a mixture of 30% sulphuric acid (10 ml.) and glacial acetic acid (5 ml.) for 6 hr. The cooled reaction solution was partially neutralised and filtered from a dark material that separated. The filtered solution deposited fine crystals on standing, which melted at 94-96° on crystallisation from water. Identified as  $\alpha$ -naphthol by properties and mixed melting point.

**Neber reaction with  $\alpha$ -tetralone oxime.**—The oxime (6.4 g.) was dissolved in sodium hydroxide solution (4 g. in 60 ml. of water) and under ice-cooling treated with *p*-toluene sulphonyl chloride (10 g.) dissolved in acetone (30 ml.) over a period of an hour with stirring, the temperature being maintained at 14-17°. After addition, the mixture was left standing in the cold for 40 minutes, the resulting solid collected and washed free of alkali. m.p. 96-97° from light petrol. The esterification with toluenesulphonic acid chloride did not proceed by employing the conventional pyridine method.

**Rearrangement of the ester to amino tetralone.**—The crystallised *p*-toluene-sulphonic ester (10 g.) was suspended in absolute ethanol (30 ml.) and treated with potassium ethoxide (1.3 g. of

potassium dissolved in 15 ml. of absolute ethanol). The mixture was shaken for half-an-hour when the potassium sulphonate separated out and the solution became green. After filtering and washing the sulphonate with absolute ether, the combined ethanol-ether filtrate was poured into more ether and extracted with 0.5 N hydrochloric acid. The reddish solution thus obtained was reduced to a small bulk under vacuum. The concentrate was treated with excess of sodium hydroxide solution and shaken with benzoyl chloride. The benzoyl derivative soon separated out. It formed amethyst coloured needles on crystallisation from ethanol, m.p. 174-177° (Found: C, 76.7, H, 5.9. Calculated for  $C_{17}H_{15}O_2N$ : C, 76.9, H, 5.7).

The free amine was extremely unstable. Its ethereal solution gave the acetyl derivative, m.p. 155-158°, on being left with acetic anhydride at room temperature (30° C.).

Dept. of Organic Chemistry, P. S. RAMAN.  
University of Madras,  
Madras-25, September 10, 1956.

1. Haworth, R. D., Jones, B. and Way, Y. M., *J. Chem. Soc.*, 1943, 10.
2. Kornfeld, E. C., Fornefeld, E. J., Kline, G. B., Mann, M. J., Morrison, D. E., Jones, R. C. and Woodward, R. B., *J. Amer. Chem. Soc.*, 1956, **78**, 3087.
3. Cram, D. and Hatch, M., *Ibid.*, 1953, **75**, 33 and 38.

#### LIPOCHROMES OF *GYROSTOMA* SP. (SEA ANEMONES)

THE varied colours of the sea anemones have attracted the attention of a number of workers. Fabre and Lederer<sup>1</sup> have isolated the pigment actinioerythrin from the sea anemone *Actinia equina*. Heilbron, Jackson and Jones<sup>2</sup> confirmed this and were able to prepare a hydrolysis product violerythrin from the same pigment. Working with more species of sea anemones the same authors have isolated sulcatoxanthin from *Anemonia sulcata* and a wax-like pigment akin to actinioerythrin from *Tealia felina*. Fox and Moe<sup>3</sup> have isolated an astacene-like pigment from the Pacific coast anemone *Epiactis prolifera*. The pigments of the plumose anemone *Metridium senile* have also been studied by Fox and Pantin.<sup>4</sup>

The sea anemone *Gyrostoma* sp. found along the shores of Bombay is characterised by a red pigmentation. The isolation of the main pigment from this animal and some preliminary

observations made on it are communicated in this note.

The method followed for extraction of the pigments was essentially the same as described by Heilbron, Jackson and Jones.<sup>2</sup> Fifty anemones were cut and pressed between filterpapers to remove as much moisture as possible. They were then minced and the entire mass extracted in stages with acetone-ether (1:1 vol.) in a Waring blender till the extract was colourless. The extract was distilled under reduced pressure to remove the solvent, and the pigments taken up in light petroleum. The phosphatides and sterols were removed by freezing and adding excess of acetone. The solvent was again distilled off under reduced pressure, the pigments taken up in petroleum ether and then subjected to adsorption chromatography on a column of alumina (Brockmann standardised Merck quality). The column was developed with benzene. An intense violet black zone was formed at the top of the column and a yellow pigment spectroscopically identified as carotene passed through. The violet black zone was eluted and adsorbed on a calcium carbonate column when other impurities such as traces of phosphatides and sterols were removed.

The violet black pigment was eluted and efforts were made to recrystallise it from absolute alcohol. Due to paucity of material, it was only possible to obtain the pigment in a wax-like form. The absorption maxima of this pigment in  $CS_2$  was found to be at 574, 538 and 497  $m\mu$  and in petroleum ether (40-60°) to be at 534, 497 and 490  $m\mu$ , whereas in ethyl alcohol a broad band (577-518  $m\mu$ ) was noticed.

From its absorption spectra studies the pigment seems to be identical with actinioerythrin isolated by Fabre and Lederer<sup>1</sup> and later by Heilbron, Jackson and Jones<sup>2</sup> from the sea anemone *Actinia equina*.

Dept. of Biochemistry, M. V. RAJAGOPAL.  
Institute of Science, KAMALA SOHONIE.  
Bombay, July 7, 1956.

1. Fabre, R. et Lederer, E., *Bull. Soc. Chim. Biol.*, 1934, **16**, 105.
2. Heilbron, I. M., Jackson, H. and Jones, R. N., *Biochem. J.*, 1935, **29**, 1334.
3. Fox, D. L. and Moe, C. R., *Proc. Nat. Acad. Sci., U.S.*, 1938, **24**, 23.
4. — and Pantin, C. F. A., *Trans. Roy. Soc. (London)*, 1941, **230 B**, 415.

# VITEXIN FROM VITEX PEDUNCULARIS WALL

THE isolation of vitexin from the root bark and leaves of *Vitex peduncularis* Wall, has recently been reported by Sharma,<sup>1</sup> who also suggested a pentahydroxy-flavanone structure. The same roots have been under chemical examination and we report in this communication the results obtained during this investigation. This is found to be identical with a similar substance isolated from *Vitex littoralis*.<sup>2</sup> Vitexin has the following properties. Its molecular formula works out to be  $C_{21}H_{20}O_{10}$ , m.p. 265-66° C. (Found: C, 58.4, 58.6; H, 4.6, 4.8;  $C_{21}H_{20}O_{10}$  requires C, 58.3 and H, 4.6%) and has no methoxyl groups. It formed a heptaacetate, m.p. 257-59° C. (Found: C, 57.8, 58.0; H, 4.7, 4.8;  $C_{35}H_{34}O_{17}$  requires C, 57.9 and H, 4.5%) indicating the presence of seven hydroxyl groups instead of five as indicated by Sharma,<sup>1</sup> or eight as indicated by Nakaoki.<sup>3</sup> Normal methods of methylation using dimethyl sulphate and aqueous alkali or methyl iodide and anhydrous potassium carbonate in acetone solution yielded no crystalline derivatives. However, methylation using vitexin heptaacetate and dimethyl sulphate and alkali in acetone solution following the procedure of Rao and Seshadri,<sup>4</sup> gave a crystalline trimethyl ether, m.p., 290-91° C. (Found: C, 61.0, 60.9; H, 5.7, 5.8;  $-OCH_3$ , 20.0; 19.8;  $C_{24}H_{26}O_{10}$  requires C, 60.8; H, 5.5 and  $-OCH_3$ , 19.6%), which in turn formed a tetraacetate, m.p., 217-18° C. (Found: C, 59.9, 60.1; H, 5.4, 5.6;  $C_{32}H_{34}O_{14}$  requires C, 59.8 and H, 5.3%), clearly indicating that out of the seven hydroxyl groups, only three are phenolic and the rest alcoholic in nature. Oxidation of vitexin or vitexin trimethyl ether with alkaline hydrogen peroxide yielded *p*-hydroxy-benzoic acid or anisic acid respectively while absolute alcoholic potash hydrolysis of vitexin trimethyl ether yielded *p*-methoxy-acetophenone identified as its 2:4-dinitrophenyl-hydrazone. The formation of *p*-methoxy-acetophenone during the alcoholic potash fission clearly indicates that it belongs to the flavone group. The colour of the substance (canary yellow), the production of a red colour in alcoholic solution with magnesium and hydrochloric acid and the formation of a tetranitro-apigenin<sup>2</sup> on nitration of vitexin, clearly indicate that vitexin is an apigenin derivative. The difference in the molecular formula of vitexin and apigenin, leaves six carbon atoms to be accounted along with four alcoholic hydroxyl groups and one oxygen atom. This could be accounted for only by a

glucose unit which should be present in the phloroglucinol part of the benzopyrone nucleus and not in the side phenyl nucleus. The exact nature of the glucosyl link in vitexin is still under investigation.

Dept. of Chemistry, CH. BHEEMASANKARA RAO.  
Andhra University, V. VENKATESWARLU.  
Waltair, July 14, 1956.

1. Sharma, V. N., *J. Sci. Ind. Res. India*, 1955, 267.
2. Perkin, A. G., *J. Chem. Soc.*, 1898, 73, 1019.
3. Nakaoki, T., *J. Pharm. Soc. Japan*, 1944, 64, No. 11A, 57; *C.A.*, 1952, 46, 108d.
4. Rao, P. S. and Seshadri, T. R., *Proc. Ind. Acad. Sci.*, 1941, 14 A, 110.

## ADSORPTION OF CARBON MONOXIDE BY NICKEL: FORMATION OF NICKEL CARBONYL

MOND AND CO-WORKERS<sup>1,2</sup> showed that CO and nickel powder react at 30° C. and above to form a carbonyl of the composition  $Ni(CO)_4$ . During our studies on the adsorption of CO by nickel powder in the range -191° C. to 53° C. we observed that the maximum adsorption occurred at 0° C. Since chemisorption seemed to predominate at 0° C. several experiments under different conditions were carried out to ascertain exactly the adsorption complexes formed at that temperature. This work involved accurate determinations of the adsorption and the subsequent desorption at the same temperature by evacuation by a Töpler pump with arrangements to decompose the desorbed products so as to collect and determine them accurately.

The apparatus employed is shown diagrammatically in Fig. 1. The nickel powder catalyst

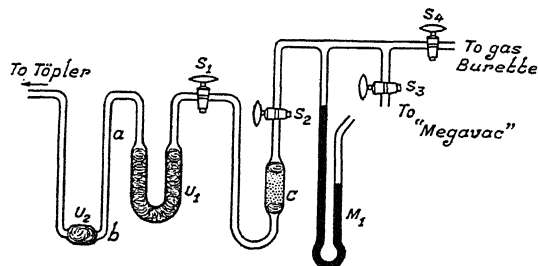


FIG. 1

as well as the carbon monoxide employed for this work were prepared with great care observing all the necessary precautions.

The tube C containing nickel powder (6.1 g. kept between glass wool plugs) communicated with the gas burette via stopcocks  $S_2$  and  $S_4$  on one side and with U tubes  $U_1$  and  $U_2$  and the Töpler pump via stopcock  $S_1$  on the other. The U tubes contained purified and ignited

glass wool. The nickel powder in tube C was kept heated at 300° and exhaustively degassed by means of a Cenco megavac pump, keeping taps  $S_1$  and  $S_4$  closed while  $S_2$  and  $S_3$  were open, whereas the system to the left of  $S_1$  was evacuated thoroughly by means of the Töpler pump. After evacuation and with taps  $S_1$ ,  $S_3$  and  $S_4$  closed, the catalyst tube C was kept surrounded by a bath of melting ice and maintained at 0° C. throughout the experiment. After cooling for about an hour, the adsorption was started by admitting known quantities of CO successively from the gas burette into the tube C by operating tap  $S_4$  and allowing an adequate interval after which the pressure was noted from manometer  $M_1$ . It was observed that the intake of CO by nickel was very rapid at first but slowed down after 48 hours. The desorption was then commenced, keeping  $U_1$  cooled at -191° in a liquid air-bath while  $U_2$  was kept heated at 190° by means of a liquid paraffin-bath, the tube C being in the ice-bath. Stopcock  $S_1$  was slowly opened when the gas from the catalyst tube and the manometer of the adsorption apparatus flowed into the Töpler pump through  $U_1$  and  $U_2$ . The pump was operated very gently at first so that the desorption was relatively slow. The system was finally evacuated thoroughly and the gas obtained was collected and measured in the gas burette. Stopcock  $S_1$  was then closed and the liquid air-bath removed while still maintaining  $U_2$  at 190°. Colourless crystals were seen inside  $U_1$  and these melted soon and evaporated liberating a large volume of gas which flowed into the Töpler and at the same time depositing a thick and bright mirror of nickel in the portion a-b in  $U_2$ . The Töpler pump was operated until no more gas came off. The CO thus obtained was collected and measured. The portion of the tube containing the nickel deposit was cut off and the nickel dissolved and estimated by the dimethyl glyoxime method.

The experiment was repeated several times with intervening soaking at 300° of the nickel powder in hydrogen and thorough degassing. The typical results of two such experiments are presented in Table I.

Carbon dioxide could not be detected in the desorbed gas in any of the experiments.

The stoichiometric ratios given in column 7 of the table establish that the concerned compound is  $Ni(CO)_4$ .

It can be definitely concluded that during chemisorption of CO by nickel powder at 0° C.,  $Ni(CO)_4$  is the only product formed and that there is no evidence for the formation or presence of any other surface adsorption complex.

TABLE I

Experiment	CO added c.c.	Time of contact hr.	Unadsorbed CO collected c.c.	CO obtained from decomposition of the carbonyl		Ni deposit obtained		Ni : CO in the compound desorbed and decomposed
				c.c.	in 10 <sup>-4</sup> g. mol.	mg.	in 10 <sup>-4</sup> g. mol.	
1	116.3	48	15.1	96.9	43.3	63.0	10.7	1 : 4.046
2	115.2	60	6.1	106.3	47.5	70.1	11.9	1 : 3.993

Further work is in progress on the adsorptive characteristics of the nickel mirrors obtained from experiments of this type as well as similar detailed studies of adsorption of carbon monoxide by nickel at other temperatures.

V. SRINIVASAN.

K. R. KRISHNASWAMI.

Dept. of General Chem.,  
Indian Institute of Science,  
Bangalore, August 22, 1956.

1. Mond, L., Langer, C. and Quincke, F., *J.C.S.*, 1890, 57, 749.
2. Mond, L., *J. Soc. Chem. Ind.*, 1895, 14, 945.

#### DETECTION OF GROWTH FACTORS IN CULTURE FILTRATES OF FUSARIA

THE occurrence of certain unknown growth factors in culture filtrate of *Fusaria* has been previously shown by stimulation of rooting in cut shoots of tomato<sup>1</sup> and cotton<sup>2</sup> treated to these filtrates and recently by the *Avena* cylinder technique.<sup>3</sup> Another simple and rapid test for growth factors in *Fusarium* culture filtrates is described here which was found to give very consistent and satisfactory results in large-scale tests of filtrates.

A 4" × 4" square piece of gauze cloth was tied to the mouth of a 100 ml. beaker with the cloth sagging concave inside the beaker. The required quantity of *Fusarium* test culture filtrate (dialyzed) was added to 100 ml. distilled water in the beaker. Twenty-five paddy seeds (Co. 17 variety), pre-soaked for 4 hours in distilled-water, were spread on the gauze cloth and covered lightly by folding the loose ends of the cloth, the beakers incubated in a moist chamber at 27-29° C. for three days and the root length of the germinating paddy measured. Increase in root length achieved in the case of culture filtrates of many *Fusarium* species (Plate I, Figs. 2, 4), over the control (distilled-water), indicated the presence of growth factors in the filtrate whilst filtrates of certain other species inhibited root growth, as for

example (*F. moniliforme* and *F. udum*) (Plate I, Figs. 1, 5). Similar increase in root length was also observed in the case of wheat and mustard seeds treated to the culture filtrates but paddy gave best results.

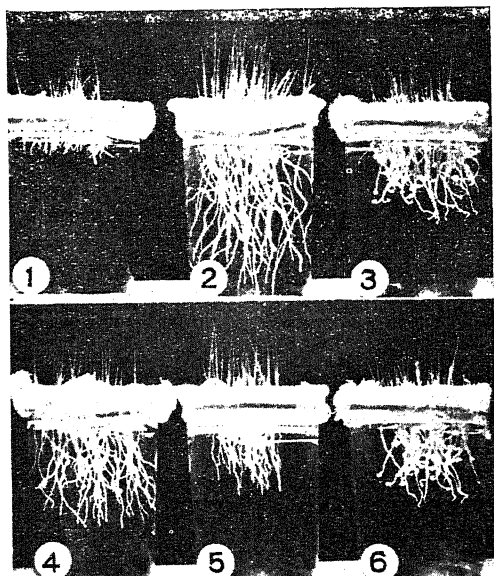


PLATE I. FIGS. 1-6.

Effect of culture filtrates of (1) *F. moniliforme*, (2) *F. casinfectum*, (4) *F. orthoceras* and (5) *F. udum* on root growth of paddy; (3) and (6) are controls.

Bioassay and chromatographic analysis indicated the presence of B vitamins, various amino acids, organic acids and sugars in the culture filtrates and these were similarly tested on paddy. None of the sugars, organic acids and the B vitamins increased root length but marked stimulation was achieved with tyrosine and phenylalanine at 25, 50 and 100 ppm. concentrations which was comparable to increase in root length produced by *Fusarium* culture filtrate at 5% level. Other amino acids exerted no stimulatory effect. These results indicate that stimulation of root elongation in paddy produced by culture filtrates of *Fusaria* are in part due to tyrosine and phenylalanine present in the filtrates. Details of this work will be published elsewhere.

I thank Prof. T. S. Sadasivan for his criticism and interest in this work and the National Institute of Sciences of India for the award of an I.C.I. Research Fellowship.

University Botany Lab., C. S. VENKATA RAM.  
Madras-5, July 30, 1956.

1. Mostafa, M. A. and Naim, M. S., *Nature, Lond.*, 1948, **162**, 575.

2. Kalyanasundaram, R. and Lakshminarayanan, K., *Ibid.*, 1953, **171**, 1120.

3. Venkata Ram, C. S., Unpublished.

## BACTERIAL RED STRIPE DISEASE OF SUGARCANE CAUSED BY *XANTHOMONAS RUBRILINEANS* IN BOMBAY STATE

SPECIMENS of sugarcane leaves (variety Co. 419) affected by bacterial red stripe disease, were received from the Godavari Sugar Mills, Kanhegaon, District Ahmednagar, in October 1955. The leaves were marked with long, narrow, dark red, longitudinal streaks which were  $\frac{1}{2}$ -1 mm. wide and coalescing at places to form broad bands. A species of *Xanthomonas* was isolated from the lesions and proved pathogenic to sugarcane (variety Co. 419) on re-inoculation. Jowar (*Sorghum vulgare* Pers.) was also successfully inoculated. A study of the morphological and biochemical characters of the organism showed that it was indistinguishable from *Xanthomonas rubrilineans* (Lee *et al.*) Starr and Burkholder.

McRae (1933)<sup>1</sup> and Padwick (1940)<sup>2</sup> reported occurrence of bacterial red stripe of sugarcane in India but the organism has not been isolated nor has its pathogenicity to sugarcane been proved as yet. This is, therefore, the first time that this organism has been isolated and identified.

Further work is in progress.

Plant Pathological Lab.,

College of Agriculture,

Poona-5, July 7, 1953.

V. P. BHIDE.

R. K. HEGDE.

M. K. DESAI.

1. McRae, W., "New diseases reported during the year 1932," *Internat. Bull. Pl. Protect.*, 1933, **7**, 79-80.

2. Padwick, G. W., "Report of the Imperial Mycologist," *Sci. Report, Agric. Res. Inst.*, New Delhi, 1938-39, 1940, 105.

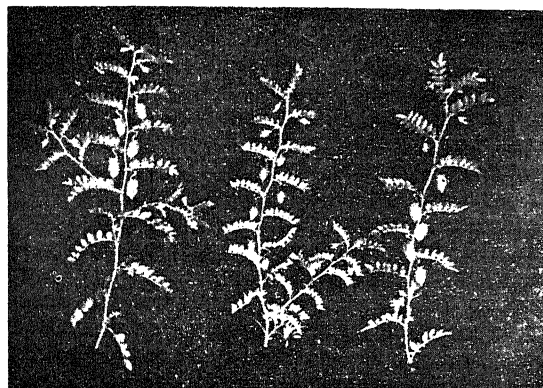
## TINY SEED AND TINY POD SEGREGATES IN BENGAL GRAM (*CICER ARIETINUM*)

A NUMBER of mutants and segregates in flower, pod and seed characters in Bengal gram (*Cicer arietinum* L.) have been reported by many workers.<sup>2-5</sup> Ekbote<sup>1</sup> reported a tiny leaf mutant in Bengal gram but no difference in pod and grain size was observed in the mutant. So far, occurrence of tiny seed and tiny pod segregates or mutants have not been reported by any one. The present article therefore deals with the description as well as the inheritance of such segregates isolated at the Agricultural Research Station, Niphad, District Nasik.

In 1945-46, in the course of study of some hybrid material in Bengalgram, two plants altogether different from the normals were first spotted in the  $F_3$  lines 140 and 440 of a cross



between Wh.F. Wh.Gr. III  $\times$  Chafa. In  $F_1$  generation, two types of grain sizes were observed in culture 440 and the same have been isolated. The plants appear to have arisen through reduced leaf, pod and seed sizes and were found to breed true in further generations (Figs. 1 and 2). The segregates were studied



White flower  
White grain-III

FIG. 1. Showing the leaf and pod variation of the mutant in comparison with the parents.

for their pod and seed size and the description of the same together with the parents of the cross is given in Table I.

TABLE I

Showing pod and seed characters of the three segregates in comparison with Chafa and Wh.F. Wh.Gr. III

Characters	Varieties				
	Chafa	Wh.F. Wh. Gr. III	Segregate 140-14	Segregate 440-6	Segregate 440-9
Mean length of pod in cm.	1.63	1.7	1.2	1.16	1.18
Mean breadth of pod in cm.	0.81	0.83	0.54	0.54	0.54
100 grain weight in g.	16.33	10.23	5.40	1.49	3.15

From Table I it will be seen that there is a definite reduction in pod and seed size of these segregates. As far as pod size is concerned, no marked difference is seen among these three segregates, while in seed size definite variation is observed (Fig. 2). There is definite variation in leaf size also and observations on this character will be published elsewhere.

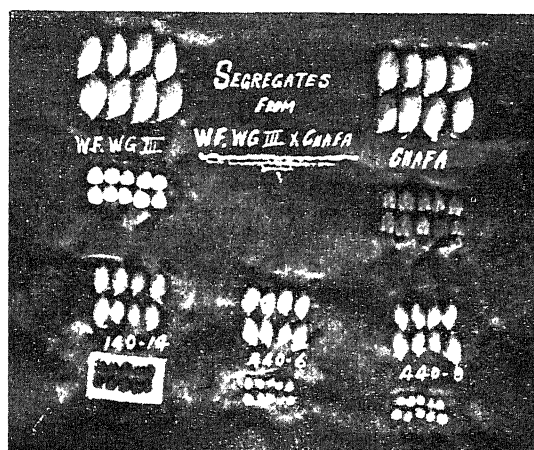


FIG. 2. Segregates from Wh.F. Wh.Gr. III  $\times$  Chafa.

From inheritance study, segregate 140-14 only was crossed with a normal variety "Chafa", an improved strain of the station in the year 1947-48. The  $F_1$  was normal. As a very small population was available for study in  $F_2$ , confirmatory studies were carried out on the progenies of all 23 plants in  $F_3$ . Individual plants from each line of  $F_3$  were studied for their pod and seed size characters. Details of  $F_2$  and  $F_3$  studies are given in Tables II and III.

TABLE II

$F_2$  segregation in the cross 140-14  $\times$  Chafa

Phenotypes		O's. (O)	Calc. (C)	(O-C)	(O-C) <sup>2</sup> /C
Normal	..	16	17.25	-1.25	0.09
Tiny seed and tiny pod	..	7	5.75	1.25	0.27
TOTAL	..	23	23	..	0.36

$P=0.5$  to  $0.7$ ;  $\chi^2=0.36$

TABLE III

Behaviour of segregates in  $F_3$

Phenotypes of families	Obs. (O)	Cal. (C)	(O - C)	(O - C) <sup>2</sup> /C
Normal ..	5	5.75	-0.75	0.098
Tiny seed and tiny pod ..	7	5.75	1.25	0.27
Segregations ..	11	11.50	-0.50	0.021
TOTAL ..	23	23	..	0.38

$P=0.8$  to  $0.9$ ;  $\chi^2=3.89$ .

The goodness of fit test of the  $F_2$  and  $F_3$  results proves that segregation of the character



tiny seed and tiny pod is monogenic giving 3 normal to 1 tiny seed and tiny pod plants. In the  $F_2$  and  $F_3$  study it is observed that the tiny pods always contain tiny seeds only. No normal pods show tiny seed in it. The segregates have also been crossed with other varieties available at the station and the details of these studies as well as the genetic symbols for these segregates will be published in due course.

My thanks are due to Sri. J. A. Patil, B. B. Kushare, and other staff members who have helped to collect the data. I am highly obliged to Dr. Solomon for going through the article and giving valuable suggestions.

Crop Res. Section, B. B. CHAUDHARI.  
Dept. of Agriculture,  
Bombay State, Poona-5,  
June 28, 1956.

1. Ekbote, R. B., *Curr. Sci.*, 1937, 5, 648.
2. —, *Ind. J. of Genetics and Plant Breeding*, 1942, 3, 50.
3. Ramanujam, S. and Singh, S., *Ibid.*, 1945, 5, 46.
4. Argikar, G. P., *J. Ind. Bot. Sci.*, 1952, 31 (4), 362.
5. Dixit, P. D., *Ind. J. Agric. Sci.*, 1932, 2, 391.

#### SOME MYCOPHAGOUS INSECTS AND THEIR PARASITES ASSOCIATED WITH SUGARCANE

JOHNSON<sup>1</sup> AND ECKSTEIN<sup>2</sup> observed thrips and earwig (*Forficula auricularia* L.) on maize smut and other fungi. Ramakrishna Iyyar<sup>3</sup> collected *Anaphothrips fungivora* feeding on wheat rust. Hayward<sup>4</sup> found *Phalacrids*, *Brachytarsus zeæ* and *Anthicus albifasciatus* associated with sugarcane smut.

During a study of sugarcane crop and *Saccharum spontaneum* variants at the Sugarcane Breeding Institute, Coimbatore, the author collected the following four species of insects and one species of the *Acarina* from sugarcane smut and two species from *S. spontaneum* rust. While studying their biology and habits, three parasites were also reared from these insects; of these *Apanteles aræceri* has already been described by Wilkinson<sup>5</sup> from unidentified cocoon. Barring *Phalacrus immarginatus* and *Kittada coimbatorensis* which were reported by the author earlier,<sup>6,7</sup> all other insects appear to be first records of mycophagous insects and their parasites associated with sugarcane.

The following insects were collected from sugarcane smut (*Ustilago sitaminea*) during August to December 1955:—*Phalacrus immarginatus* Chap. (Coleoptera—Phalacridæ); *Diphyl-*

*lus* sp. nr. *egens* Grouvella (Coleoptera—Cryptophagidæ); *Trocetes bostrychophilus* Badonnel—Indian race (Psocoptera—Psicidæ);? *Ascalenia* sp. (Lepidoptera—Cosmopterygidæ); *Blattiscius keegani* Fox (Acarina—Acoesejidae).

Insects from rust (*Puccinia kuehnii*) of *Saccharum spontaneum*; *Kittada coimbatorensis* Agarwal (Diptera—Itonididæ); *Anaphothrips fungivora* Ramakrishna Iyyar (Thysanoptera—Thripidae).

Parasites of above insects—*Apanteles aræceri* Wilk. (Hymenoptera—Braconidæ, reared from *P. immarginatus*); *Ceraphron* sp. (Hymenoptera—Ceraphronidæ, from *K. coimbatorensis*); *Amitus* sp.? (aleurolobi) Mani. (Hymenoptera—Platygarteridæ, from *K. coimbatorensis*).

These small insects have not so far been considered to be of any economic importance, presumably because their populations did not warrant inclusion among insects of economic importance. The immature stages of almost all the above insects were observed feeding on the spores. On opening alimentary canal, these spores could easily be seen under high magnification.

Although these insects may benefit the host plant by consuming some of the spores, their population is hardly sufficient to control the fungus. On the other hand, it may be one of the ways of carrying the fungus spores, which are adhering to their legs and other body parts to the healthy canes and thus spreading the fungus or at least serving as source for secondary infection. The insects being small are in all probability carried by strong winds, thus aiding in the dissemination of the spores to new plants. Being quite active, the insects themselves migrate to neighbouring plants, thus inadvertently helping the spread of the spores.

Grateful thanks are due to Shri N. L. Dutt for encouragement during the course of these studies and to the Commonwealth Institute of Entomology for kindly identifying the insects.

Sugarcane Breeding Inst., R. A. AGARWAL.  
Coimbatore, July 16, 1956.

1. Johnson, E. C., *Phytopathology*, 1911, 1, 18.
2. Eckstein, F., *Nachr. Bull. Deuts. Pflsch. Dienst.*, 1931, 11, 2.
3. Ramakrishna Iyyar, T. V., *Memoirs of the Dept. of Agri. in India*, 1928, 10, 268.
4. Hayward, K. J., *Cir. Estac. Expt. Agric. Tucuman*, 1943, No. 123, p. 1.
5. Wilkinson, D. S., *Bull. Ento. Res.*, 1928, 19, 91.
6. Agarwal, R. A., *Curr. Sci.*, 1956, 25, 27.
7. —, *Ibid.*, 1956, 25, 129.

# A NEW MUTATION IN *CAJANUS* *CAJAN* MILLSP.

HOOKER<sup>1</sup> described *Cajanus indicus*, Spreng (*C. cajan* Millsp.) as a monotypic species in India having, besides the other characters, lanceolate leaflets, keel petals united at the top and monocarpellary pistil. Later, Singh *et al.*<sup>2</sup> reported a new type under *C. obcordifolia*, Singh, differing from the original species *C. indicus* by obcordate leaflets and free keel petals (not united).

Poona, by Shri D'Cruz whose kind help is gratefully acknowledged by the author.

Crop Research Station, N. B. KAJJARI.  
Dept. of Agriculture, Bombay,  
Poona, June 13, 1956.

1. Hooker, J. D., *Flora of British India*, Reece & Co. London, 1879, 2, 217.
2. Singh, D. N. *et al.*, *Indian J. Agric. Science*, 1942, 12, 779.
3. Pandya, P. S., Patil, J. A. and Choudhari, B. B., *Poona Agric. College Magazine*, 1954, 45, 1.

TABLE I

Sl. No.	Name	Leaflets shape	Keel petals	Pistil	Apex of leaflets	Petal colour
1	<i>C. cajan</i> (Normal)	Lanceolate	United at the top	Simple or monocarpellary	Acute to slightly acuminate	Pale yellow, back of standard veined with red or yellow
2	Round leaf	Obovate	do	do	Obtuse	Pale yellow, back of standard with self-coloured veins
3	Tiny leaf	Lanceolate	do	do	Acute to slightly acuminate	Pale yellow, back of standard veined with red
4	<i>C. obcordifolia</i>	Obcordate	Free in the open flower	do	Mucronate & retuse	do
5	New Mutant	do	United at the top	Polycarpellary & Apocarpous	do	do

Pandya *et al.*<sup>3</sup> reported two leaf mutants in *C. cajan*, one having obovate leaflets with rounded base and apex and the other having tiny leaflets with short petiole.

In 1953, at the Agricultural Research Station, Annigeri, District Dharwar, a new mutant was detected in the progeny row number 115-3 in the selections from local varieties. This mutant has obcordate leaflets and keel petals united at the top. Further, its pistil is polycarpellary (with two or three pods in each calyx) and apocarpous.

Table I gives the contrasting characters of the four types described above.

During 1954, 48 progenies were raised from selfed seeds of the new mutant and it was observed that all the plants were breeding true, to the above characters. Similarly, these results were confirmed in 1955 by raising 200 progenies.

The new mutant along with normal *tur* was subjected to cytological examination but no difference in the number and morphology of chromosomes were observed. The chromosome number in both the types was identical, being  $2n = 22$ .

The cytological examination was carried out in the Laboratory of the Economic Botanist to Government, B. S. College of Agriculture,

## A SYNTHESIS OF 4-ACETOMETHYL-COUMARIN DERIVATIVES

SETHNA AND SHAH<sup>1</sup> observed that orcacetophenone and its monomethyl ether behave abnormally when subjected to Kostanecki-Robinson acylation in producing coumarins. They assigned provisionally a 4-acylmethylcoumarin structure to these compounds in preference to the alternative 3-acyl-4-methylcoumarin structure. The present investigation was undertaken to provide synthetic evidence bearing on the structure of these compounds.

As a model for the synthesis of 4-acetomethylcoumarins, a synthesis of 4-acetomethyl-7-methylcoumarin was first carried out. 7-Methylcoumarin-4-acetic acid<sup>2</sup> was converted to a crystalline acid chloride (I) which was then condensed with sodio-diethylmalonate. Acid hydrolysis of the condensation product finally yielded the required 4-acetomethyl-7-methylcoumarin (II), colourless silky needles, m.p. 199-200° (Found: C, 72.6; H, 5.9;  $C_{13}H_{12}O_3$  requires C, 72.2; H, 5.6%) dinitrophenylhydrazones, deep orange needles, m.p. 219-220° (Found: N, 14.0;  $C_{19}H_{16}O_6N_2$  requires N, 14.2%) semicarbazone, colourless small needles, m.p. 227-228° (Found: N, 15.6;  $C_{14}H_{16}O_3N_3$  requires N, 15.4%).

The same coumarin (II) was also synthesised in better yields by an alternative route by treating (I) with excess of diazomethane and reducing the corresponding crystalline diazo ketone with hydriodic acid.<sup>3</sup>

The starting material required for the synthesis of 4-acetomethyl-5-methyl-7-methoxycoumarin is 5-methyl-7-methoxycoumarin-4-acetic acid (III), which could possibly be obtained from ethyl 5-methyl-7-hydroxycoumarin-4-acetate-8-carboxylic acid (IV) by decarboxylation, methylation and hydrolysis respectively. Attempts to synthesise the latter by condensing *p*-oresellinic acid with ethyl acetonedicarboxylate in presence of concentrated sulphuric acid, resulted in the formation of 4:5-dimethyl-7-hydroxycoumarin-8-carboxylic acid, m.p. 225° (d), obtained earlier by Sethna and Shah<sup>4</sup> by condensing *p*-oresellinic acid with ethyl acetoacetate. Coumarin (IV) could, however, be obtained by using phosphorous oxychloride as the condensing agent. It crystallised from alcohol in colourless needles, m.p. 230° (d) and gave a strong bluish green fluorescence with alkali and a reddish violet colouration with alcoholic ferric chloride. (Found: C, 59.0; H, 4.8; C<sub>15</sub>H<sub>14</sub>O<sub>7</sub> requires C, 58.8; H, 4.6%). When heated above the melting point, (IV) was decarboxylated to ethyl 5-methyl-7-hydroxycoumarin-4-acetate, colourless needles, m.p. 171-172°, giving a bluish green fluorescence with alkali (Found: C, 64.1; H, 5.3. C<sub>14</sub>H<sub>14</sub>O<sub>5</sub> requires C, 64.1; H, 5.3%). This was methylated with dimethyl sulphate to ethyl 5-methyl-7-methoxycoumarin-4-acetate, colourless needles, m.p. 126-127° (Found: C, 65.6; H, 5.9; C<sub>15</sub>H<sub>16</sub>O<sub>5</sub> requires C, 65.2; H, 5.8%), which was then hydrolysed with acid or alkali to (III), colourless needles, m.p. 177-178° (d). (Found: C, 63.3; H, 4.9; C<sub>13</sub>H<sub>12</sub>O<sub>5</sub> requires C, 62.9; H, 4.8%.)

Reduction of the diazo ketone obtained from the acid chloride of (III) yielded finally 4-acetomethyl-5-methyl-7-methoxycoumarin, colourless needles, m.p. 156-157° (Found: C, 67.8; H, 5.5. C<sub>14</sub>H<sub>14</sub>O<sub>4</sub> requires C, 68.3; H, 5.7%), dinitrophenylhydrazone, small dark orange needles, m.p. 178-180° (Found: N, 11.7. C<sub>20</sub>H<sub>14</sub>O<sub>7</sub>N<sub>4</sub> requires N, 13.1%). It differed from the Kostanecki-Robinson acetylation product of oracetophenone monomethyl ether, m.p. 123-124°, obtained by Sethna and Shah. Thus, the products obtained by Sethna and Shah have, in all probability, the alternative 3-acyl-4-methylcoumarin structure, the synthesis of which is in progress.

Microanalyses were carried out by Dr. G. D. Shah, Mr. V. S. Pansare and Mr. V. N. Mulay. Fuller details will be published elsewhere.

National Chemical Lab. of India, J. L. BOSE.  
Poona, May 26, 1956. R. C. SHAH.

1. Sethna, S. M. and Shah, R. C., *J. Indian Chem. Soc.*, 1940, **17**, 239; 487.
2. Fries, K. and Volk, W., *Ann.*, 1911, **379**, 90.
3. Wolfrom, M. L. and Brown, R. L., *J. Amer. Chem. Soc.*, 1943, **65**, 1516.
4. Sethna, S. M. and Shah, R. C., *J. Indian Chem. Soc.*, 1940, **17**, 211.

#### A RECORD OF *GLOBIDIUM LEUCKARTI* (FLESCH) FROM A HORSE IN INDIA

Coccidiosis is an important protozoon infection in domestic animals, and is caused by members of the genera *Eimeria* and *Isospora*. Sampson<sup>1</sup> recorded a disease due to coccidia in a horse without describing the parasite. Selan and Vittoria<sup>2</sup> claimed to have detected a coccidian in the lungs and gall-bladder of a horse in Italy. But the infection has not so far been described satisfactorily to form a definite opinion about the species causing it. Flesch<sup>3</sup> made an interesting record of *Globidium* from the small intestine of a horse and he gave the name *Globidium leuckarti* to it. Reichenow<sup>4</sup> described large oocysts in the feces of donkeys and he considered these oocysts as the mature macrogametes of *G. leuckarti*.

The present author while examining a sample of feces collected from a horse at Mangrol (Bombay State) in October 1955, came across a large number of oocysts belonging to *Globidium leuckarti*. This is the first record of this species from India.

*Globidium leuckarti*—Flesch, 1883.—Oocysts large, 84 × 56 μ, deep brown in colour, oval in shape with one end pointed than the other. According to Reichenow<sup>4</sup> oocysts measure 80-87 × 55-59 μ. Outer wall of the oocyst thick, granular, brownish in colour, 5-7 μ thick and slightly thinner towards the pointed end. Micropyle distinct without a polar cap. Inner wall of the oocyst thin and transparent. Sporont 35-40 μ, circular and coarsely granular in consistency. Sporocysts four in number, 30 × 12 μ without a oocystic residuum. Sporozoites two in each sporocyst, spindle-shaped, 20 × 5 μ with a small amount of sporocystic residuum. Sporulation time 15 days during hot days of October.

*G. leuckarti* is a rare parasite of equines and the details of the developmental stages in the alimentary canal have not been studied so far. The pathogenicity of *G. leuckarti* is not definitely known except that it brings about hypertrophy of the cells of the gut. In severe cases diarrhoea mixed with blood may set in, the animal becoming emaciated. Reichenow succeeded in getting the oocysts to develop and found that they contain four sporocysts, each with two sporozoites. In other words, they are of the *Eimeria* type.

Reichenow<sup>5</sup> lists *Globidium* as a subgenus of *Eimeria* and there is a great deal of justification for this view. Reichenow states that the oocysts do not rise to the surface in salt solution when centrifuged, and it is doubtful whether the oocysts of *Globidium* will ordinarily rise in any other solution. Hence, it would be very easy to miss them in routine examinations. This is true of some members of the subgenus *Jarrina* also, so, it is not a characteristic of *Globidium* alone.

Thanks are due to Prof. N. D. Levine of University of Illinois, for having kindly identified the specimen and for offering his remarks on the parasite.

Bombay Veterinary College, L. S. HIREGAUDAR.  
Bombay-12, July 16, 1956.

1. Sampson, S. E., *Vet. Record*, 1917, **30**, 130.
2. Selan and Vitteria, *Clin. Vet. Milan*, 1924, **47**, 587.
3. Flesch, M., *Zool. Anz.*, 1883, **6**, 396.
4. Reichenow, E., *Z. Insek. Haustiere*, 1940, **56**, 126.
5. —, *In Lehrbuch der Protozoenkunde*, Gustav Fisher, Jena., Germany, Ed. Doflein, 1953, p. 850.

# ON FORECASTING HEAVY RAINFALL IN MALABAR, SOUTH KANARA AND TRAVANCORE-COCHIN DURING JUNE AND JULY

APPLICATION of the barometric pressures of two or three stations in forecasting rainfall in certain areas has been attempted by some workers. Roy<sup>1</sup> has shown how the pressure distribution at Calcutta, Berhampur and Barisal in South Bengal (pre-partition) can be usefully utilised in forecasting rainfall in South Bengal during the Nor'wester season. Similarly, Roy and Bhattacharya<sup>2</sup> have shown how the difference of pressures at Khanpur and Rawalpindi in the Punjab (P) can be used for forecasting rainfall over North-East Baluchistan during July and August. But, so far, no similar tests appear to have been made to see whether and how far heavy rainfall can be forecast from the consideration of the baro-

metric pressures of two or three stations. An attempt in this direction has been made in this note.

In the case of Malabar-South Canara and Travancore-Cochin the south-west monsoon sets in normally in the beginning of June and heavy rainfall occurs on a larger number of occasions during June and July than in other months. Station level barometric pressures at Mangalore, Calicut (Kozhikode) and Ootacamund at 08 hrs. LMT as well as rainfall records at Mangalore, Calicut, Cochin and Trivandrum during June and July for 1937-40 were analysed for the purpose.

The difference of the barometric pressure between Calicut and Mangalore in the morning at 08.00 hrs. L.T. on a day was noted and the rainfall recorded in the subsequent 24 hours ending at 08.00 hrs. L.T. on the next day at the four reporting stations, was looked into, to find out if one or more of the stations recorded 2" or more of rain. The pressure differences were grouped according to different magnitudes and the number of occasions when 2" or more of rainfall were recorded in each group were found out.

TABLE I

Pressure difference : Calicut—Mangalore									
·100" or more		·090" to ·100"		·080" to ·090"		·070" to ·080"		Below ·070"	
a	b	a	b	a	b	a	b	a	b
31	25	31	17	34	20	65	30	83	27

The analysis (Table I) together with the analysis of the pressure at the hill station, Ootacamund, show: (i) when pressure difference between Calicut and Mangalore was less than 0·1", heavy rainfall occurred only on 44% of the days; when the pressure difference was more than 0·1", the percentage was 81; (ii) when the pressure at Ootacamund was 23·015" or less heavy rainfall occurred on 35 out of 45 occasions (i.e., 76%); (iii) when the pressure at Ootacamund was 23·015" or less and the pressure difference between Calicut and Mangalore was ·07" or more, heavy rainfall occurred on 85% of the days.

The difference of pressure between Calicut and Ootacamund was also analysed, but this did not seem to be significant, except when it was 6·830" or more, when heavy rainfall occurred on 70% of such occasions.

Thus heavy rainfall in Malabar, South Kanara and Travancore-Cochin areas during June and July can be forecast from the pressure data of the above three stations, (a) when the

pressure difference between Calicut and Mangalore is  $\cdot 100''$  or more, and (b) when the pressure at Ootacamund is  $23\cdot 015''$  or less and the difference of pressure between Calicut and Mangalore is  $\cdot 070''$  or more.

The above would seem to provide a simple and useful method to forecast heavy rainfall in this region.

Jodhpur,

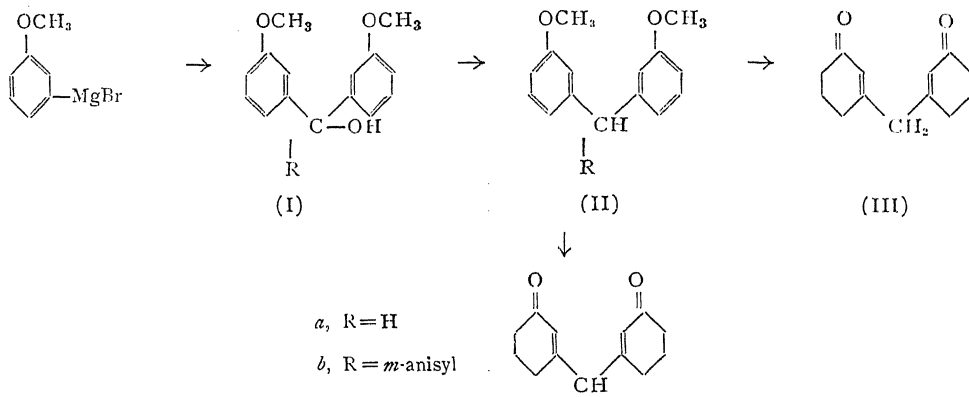
K. L. SINHA.

July 5, 1956.

1. Roy, A. K., *Ind. Meteor. Dept. Sci. Notes*, 1939, 8 (83).
2. — and Bhattacharya, R. C., *Ibid.*, 1934, 5 (58).

### SYNTHESIS OF VINYLOGUES OF $\beta$ -DI- AND $\beta$ -TRI-KETONES

THE observation that a number of biologically active substances like angustione, leptospermone, allaspidine, humulone, lupulone, usnic acid, etc.,<sup>1</sup> contain  $\beta$ -di- or  $\beta$ -tri-ketone systems, led us to make a few exploratory experiments in the synthesis of vinylogues of simple  $\beta$ -di- and  $\beta$ -tri-ketones, such as (III) and (IV). These structures are expected to show properties of  $\beta$ -di- and  $\beta$ -tri-ketones respectively, inasmuch as the intervening methyl groups are capable of transmitting the effects the keto groups. It is worthwhile therefore to examine substances with such structures for biological activity, and with this end in view we have synthesised di-(3-oxo-cyclohex-1-enyl)-methane (III) and tri-(3-oxo-cyclohex-1-enyl)-methane (IV) in the following manner:



*m*-Anisyl magnesium bromide was reacted upon with *m*-anisaldehyde to obtain di-(*m*-anisyl)-carbinol (I a), b.p.  $210\text{--}212^\circ/6\text{ mm}$ . (Found: C, 73.25; H, 6.42.  $\text{C}_{15}\text{H}_{16}\text{O}_3$  requires C, 73.75; H, 6.60) which on hydrogenolysis with sodium and alcohol in liquid ammonia<sup>2</sup> furnished di-(*m*-anisyl)-methane, b.p.  $196\text{--}198^\circ/8\text{ mm}$ . (Found: C, 78.75; H, 6.80.  $\text{C}_{15}\text{H}_{16}\text{O}_2$  requires C, 78.92; H, 7.0%). Birch reduction of (II a) with lithium<sup>3</sup> and alcohol in liquid ammonia, followed by treatment of the reduced product with 10% sulphuric acid for 5 hours,<sup>4</sup> gave di-(3-oxo-cyclohexenyl)-methane (III), b.p.  $200\text{--}203^\circ/5\text{ mm}$ . (Found: C, 76.30; H, 7.72.  $\text{C}_{13}\text{H}_{16}\text{O}_2$  requires C, 76.44; H, 7.90). The deep red bis-2:4-dinitrophenylhydrazone of (III) was crystallised from ethyl acetate, m.p.  $238^\circ$  (Found: N, 19.34.  $\text{C}_{25}\text{H}_{24}\text{O}_8\text{N}_8$  requires N, 19.77).

Similarly, with ethyl *m*-methoxy-benzoate, *m*-anisyl-magnesium bromide gave tri-(*m*-anisyl)-carbinol (I b), b.p.  $260\text{--}265^\circ/2\text{ mm}$ . (Found: C, 75.10; H, 6.50.  $\text{C}_{22}\text{H}_{22}\text{O}_4$  requires C, 75.41; H, 6.33). Hydrogenolysis of (I b) as in the case of (I a) furnished tri-(*m*-anisyl)-methane (II b), b.p.  $240\text{--}243^\circ/4\text{ mm}$ . (Found: C, 78.80; H, 6.40.  $\text{C}_{22}\text{H}_{22}\text{O}_3$  requires C, 79.01; H, 6.63). The final compound, tri-(3-oxo-cyclohexenyl)-methane (IV) was obtained by Birch reduction of (II b) with lithium and alcohol in liquid ammonia followed by treatment with 10% sulphuric acid for 5 hours,<sup>4</sup> b.p.  $250\text{--}253^\circ/4\text{ mm}$ . (Found: C, 76.82; H, 7.54.  $\text{C}_{19}\text{H}_{22}\text{O}_3$  requires C, 76.48; H, 7.43). This gave a deep red bis-D.N.P. crystallised from ethyl acetate-alcohol, m.p.  $155\text{--}156^\circ$  (Found: N, 16.66.

$C_{31}H_{30}O_9N_8$  requires N, 17.12). It is interesting to note that neither of (III) and (IV) gave any colouration with alcoholic ferric chloride solution. Details will be published elsewhere.

Dept. of Chemistry,  
Panjab University,  
Hoshiarpur, May 17, 1956.

V. S. GAIND.  
S. M. MUKHERJI.

1. Birch, A. J., *J. Chem. Soc.*, 1951, 3026 and reference cited therein.
2. — and Mukherji, S. M., *Ibid.*, 1949, 2531.
3. Wilds, A. L., and Nelson, N. A., *J. Amer. Chem. Soc.*, 1953, **75**, 5360, 5366.
4. cf. Bentley, K. W. and Firth, W. C., *J. Chem. Soc.*, 1955, 2403.

#### 5:7 DIBROMO-8 QUINOLINOL COMPLEX OF MOLYBDENUM

MOLYBDENUM is precipitated from solutions of alkali molybdates by the addition of 8-hydroxy quinoline. Precipitation is quantitative<sup>1</sup> from solutions of pH ranging from 3.3 to 7.6. When the precipitate is dried at 130–140°C. it corresponds in composition to the formula  $MoO_2(C_9H_6ON)_2$ . For extracting rhenium from molybdenite, successive and repeated precipitations of molybdenum with oxine and rhenium as nitron perrhenate were suggested.<sup>2</sup> The separation of molybdenum as oxine complex cannot be very effective as it is pH-sensitive even though it is difficultly soluble in acids and alkalis after drying.<sup>3</sup> Hence the 5:7 dibromo-8 quinolinol was tried as a precipitant in the present work. To an aqueous solution of sodium molybdate excess of 1N HCl was added followed by an excess of the reagent solution in 1N HCl. There is an immediate, bulky orange yellow precipitate. Under similar conditions, oxine does not give a precipitate. The filtrate obtained after filtering the precipitate was tested for molybdenum by the standard sulphide, ferrocyanide and reduction tests and was found to be absent. Hence the 5:7 dibromo-8 quinolinol can be used for quantitative separation of molybdenum in the acidic range. The 5:7 diiodo-8 quinolinol was also tried under similar conditions and was found to be not successful.

Recently it was shown<sup>4</sup> that the dihalo substitution results in the decreased solubility and increased thermal stability of the uranyl complex. The present observation is in conformity with the above. The 5:7 dibromo-8 quinolinol chelate of uranium<sup>4</sup> was given the formula  $UO_2(C_9H_4Br_2NO)_2 \cdot C_9H_4Br_2 \cdot NOH$ , containing an extra molecule of solvation. A systematic investigation was carried out more recently<sup>5</sup> to ascertain whether the extra solvate molecule can be thermally removed and to

determine the oxide level. Similar investigations are in progress to determine the composition of molybdenum chelate.

Thanks are due to Dr. S. Pani for his helpful criticism.

Dept. of Chemistry, D. V. RAMANA RAO.  
Ravenshaw College,  
Cuttack, August 1, 1956.

1. Goto, H., *J. Chem. Soc. Japan*, 1935, **56**, 314.
2. Emeleus, H. J. and Anderson, J. S., *Modern Aspects of Inorganic Chemistry*, 1944, p. 375, G. Routledge Ltd., London.
3. Fleck, H. R. and Ward, A. M., *Analyst*, 1933, **58**, 388.
4. Moeller, T. and Ramaniah, M. V., *J. Amer. Chem. Soc.*, 1954, **76**, 5251.
5. Wendlandt, W. W., *Anal. Chem.*, 1956, **28**, 499.

#### EARLIER RECORD OF PHALACRUS IMMARGINATUS CHAMPION (COLEOPTERA, PHALACRIDAE)

IN his recent note, Agarwal<sup>1</sup> writes that the occurrence of the black beetle, *Phalacrus immarginatus* Champion, on sugarcane smut is presumably the first record. The beetles were collected by him, while feeling the smutted whips of sugarcane at Coimbatore (Madras) in August 1955. In the Entomological Collection at the Forest Research Institute, Dehra Dun, four specimens of this species are present with the following data, indicating its earlier record: Fyzabad, U.P., B. D. Gupta, Coll. 22-3-1946. From smut (*Ustilago scitaminea* Sydow) on sugarcane; G. E. Bryant det.

Again, in May 1946, one specimen collected by B. D. Gupta was received from Biswan, Sitapur (Uttar Pradesh). This species is described by Champion<sup>2</sup> from five specimens collected in sweeping the grass in April 1923 (H. G. Champion coll.) at Dhauli, Haldwani Division (Uttar Pradesh).

Forest Research Institute, R. N. MATHUR.  
Dehra Dun, August 1, 1956.

1. Agarwal, R. A., *Curr. Sci.*, 1956, **25**, 26.
2. Champion, G. C., *Ann. Mag. Nat. Hist. Ser.* 9, 1925, **16** (96), 604.

#### ON THE VISCOSITY OF SOLUTIONS IN MIXED SOLVENTS

JONES AND DOLE suggested the equation

$$\eta/\eta_0 = 1 + A\sqrt{C} + BC \quad (1)$$

where  $\eta$  and  $\eta_0$  are the viscosities of the solution and solvent respectively,  $C$ , the concentration of the electrolytes in gram moles per litre,  $A$  and  $B$  are constants. The equation has been extensively verified for aqueous solution

of electrolytes<sup>1</sup> and an expression has been derived by Falkenhagen and Vernon<sup>2</sup> for the constant A. The values calculated theoretically for this constant agree well with the experimental values.<sup>1</sup> But no satisfactory explanation of the nature of B has yet been given. Wolfenden and co-workers<sup>3</sup> attribute to B an additive character depending on the constituent ions of the electrolyte. Asmus<sup>4</sup> on the other hand suggests B to be dependent on the lyotropic number and the entropy of hydration of the constituent ions.

We have examined the viscosity of solutions of potassium chloride in mixed solvents of different compositions at  $35^\circ \pm 0.005$  with a view to determine the nature of B. Solutions of different concentrations ranging from 0.001N to 0.1N with respect to potassium chloride were examined. The accuracy of the period of flow is 0.2 seconds in 20 minutes, i.e., 1 in 6,000. The density measurements are accurate up to 4 in  $10^6$ . The solvents used were dioxan-water and acetone-water mixtures. The results fit in well with a slightly modified Jones-Dole equation

$$\eta/\eta_0 = 1 + A\sqrt{C} + BC^x \quad (2)$$

where the constants A and B have the same significance as in equation (1). It follows from equation (2) that

$$\log \{\eta/\eta_0 - (1 + A\sqrt{C})\} = \log B + x \log C \quad (2a)$$

The equivalent conductivity at infinite dilution in these mixed solvents were determined by us experimentally. Assuming equal mobility for both  $K^+$  and  $Cl^-$  ions and using Åkerlof's<sup>5</sup> data for the dielectric constant of the different composition mixtures, the value of A for each of the compositions of the mixed solvents was calculated with the help of the Falkenhagen and Vernon's equation (*loc. cit.*). The calculated values of A and the measured values of the relative viscosity were used in equation (2a). The plot of

$$\log \{\eta/\eta_0 - (1 + A\sqrt{C})\}$$

against  $\log C$  would give a straight line, from the intercept and the slope of which the values of B and x can respectively be determined.

TABLE I

% Composition of the (non-aqueous) solvent by weight	Dioxan-water mixture <sup>6</sup> $B \times 10^2$	Acetone-water mixture <sup>7</sup> $B \times 10^2$
50	12.6	13.8
40	10.0	12.6
30	5.24	6.3
20	3.98	7.9
10	2.00	4.5

It can be seen from Table I that not only is the value of B dependent on the composition of the mixture but also on the nature of the solvent. While Asmus attributes the lyotropic number to be responsible for B, we suggest that it is the nature of the sphere of solvation which determines the magnitude of B. For a single solvent, the solvation sphere is composed of one type of molecule. In case of mixed solvents, it is obvious from the data that the molecules of the constituent components of the solvent contribute to the value of B. We are of opinion that in the sphere of solvation an interaction of the type of an association reaction occurs, between the two species of molecules constituting the solvent.

The work is of interest as it provides a direct proof of the dependence of B on the nature and composition of the solvent hitherto lacking in the field of viscosity.

Dept. of Chemistry,  
Ravenshaw College,  
Cuttack-3, June 29, 1956.

D. PATNAIK.  
P. K. DAS.

1. Harned, H. S. and Owen, B. B., *The Physical Chemistry of Electrolytic Solutions*, 1950, 2nd Edition, 177.
2. Falkenhagen, H. and Vernon, R. L., *Phil. Mag.*, 1932, **14**, 537.
3. Joy, W. E. and Wolfenden, J. H., *Proc. Roy. Soc. London*, 1931, **134 A**, 413; Cox, W. M. and Wolfenden, J. H., *Ibid.*, 1934, **145 A**, 475.
4. Asmus, E., *Z. Naturforsch.*, 1949, **4**, 589.
5. Åkerlof, G., *J. Amer. Chem. Soc.*, 1932, **54**, 4125; *Ibid.*, 1936, **58**, 1241.
6. Acharya, R. C., *M.Sc. Thesis, Utkal University*, 1956.
7. Sahoo, B., *M.Sc. Thesis, Utkal University*, 1956.

## REVIEWS

**Practical Solution of Torsional Vibration Problems. (Frequency Calculations.) Vol. I.** By W. Ker Wilson. (Chapman & Hall, London, 1956. Pp. xxxii + 704. Price 105 sh.

The rapid development of engineering science has revolutionized the old concept about what an engineer should know. The thumb-rule method of studying engineering has become a thing of the past. Now an engineer must also be a scientist. He must not only be able to use his intuition and the collection of experimental data that he has learnt, but should also be able to handle basic scientific frameworks required to study any natural phenomenon.

Torsional phenomena has been the subject of a large number of scientific investigations. It is of great importance in all engineering design. In particular, its study has saved quite a lot of time and money in the design of internal combustion engines and aero engines and aircrafts. The third edition of the book has therefore been completely revised and brought up to date, though it still remains a reference book of collected formulae and solved examples of a practical nature.

The book has a historical introduction and twelve chapters dealing with frequency calculations of simple system, multi-mass systems, simple and complicated geared systems. The methods described include those of effective inertia, equivalent masses and equivalent shafts. Extensive numerical tables and graphs are given and a good bibliography can help any reader who wants to study the original papers.

The book will prove of invaluable assistance to students interested in solving practical examples and to practising design engineers.

B. R. SETHI.

**Vacuum Valves in Pulse Technique.** By P. A. Neeteson. (Philips Technical Library.) (India: Philips Electrical Co., Ltd., 7, Justice Chandra Madhab Road, Calcutta), 1955. Pp. viii + 170. Price Rs. 12-8-0.

At a time when pulse techniques are becoming extremely important, this book should be most useful to workers in electronics. Although the operation of the tube as a switch is familiar to many, the detailed mathematical treatment of switching phenomena is still not well known. The author of this book tries to give

an indication of the methods of determining the behaviour of a network in which we use electron tubes as switches. The treatment is mostly original and based on the author's own work.

The book is divided into seven main sections and each section is divided into sub-sections. This is followed by an index. The basic theory of switching and its application to switching circuits come up for preliminary description. This is followed by a treatment of electron tubes as switches. These sections, although brief, are quite clear and useful. There is then a chapter on the Operational Calculus. This could have been conveniently omitted because for those who do not know the subject, it is inadequate. There is then a chapter giving a treatment of the electron tube as a switching element and this is followed by the treatment of a detailed character on the multi-vibrator family. These two chapters are, in the reviewer's opinion, most well done and definitely appear to display a stamp of originality. Those interested in the further development of electronic switching circuits can derive considerable inspiration from these chapters.

The printing and get-up of the book is excellent. It can be strongly recommended as a valuable addition to science and engineering college libraries and should be of real interest to professional men and research workers directly engaged on the problem of switching circuits.

S. V. CHANDRASHEKHAR AIYA.

**Fossil Holothurian Sclerites—Monograph.** By Don L. Frizzell and Harriet Exline. (*Bulletin of University of Missouri, School of Mines and Metallurgy*, Rolla, Missouri, U.S.A.) Technical Series No. 89, 1955.

During the past ten years or so micropalaeontology has made phenomenal progress. Prior to this period, Foraminifera, Ostracoda and Conodonts were probably the only groups which received serious attention in the hands of micropalaeontologists and economic palaeontologists.

Recently attempts have been made towards a better understanding and usefulness of other groups of micro-organisms—both plant and animal—such as Radiolarians, Sponge spicules, Diatoms, Spores and pollen, Holothurians



Sclerites, Tintinids, Hystrichospherids, etc. We are now on the threshold of a new era in micropalaeontology and applied micropalaeontology. When sufficient advance is made in the study of these hitherto more or less "neglected" organisms micropalaeontologists will have additional "tools" with which to solve their problems of ecology, facies, etc.

A recent contribution in this sphere has been a monograph on fossil Holothurian Sclerites compiled by Don L. Frizzell and Harriet Exline. These sclerites are calcareous bodies forming the major part of the Holothurian skeletal system. They vary in size from 0.05 mm. to about 1.5 mm. and are of different shapes. Some Holothurians may have none of these sclerites, others may have only one kind, and yet others may contribute to a complex variety of sclerites.

The authors have made an extensive study of these sclerites; and in this monograph they deal first with the Holothuroidea giving an excellent account of their biology, classification, ecology, and fossil remains throughout the geologic succession. The Holothuroidea are strictly marine and have never been known living in brackish water, and therefore their remains should prove very useful in applied palaeontology. Except in rare instances, the only fossil remains of the Holothuroidea are the Sclerites and the authors have traced these remains from the earliest known records in the Palaeozoic to the Tertiary and Quaternary. The records of fossil sclerites are mostly confined to Carboniferous—Permian and Jurassic. In the Ordovician a few "sieve plates" have been doubtfully assigned to Holothuroids. The Triassic again has a poor record as also the Palaeocene, Oligocene and Upper Tertiaries. The Jurassic has by far the best known 'sclerites' remains. It is hoped that this monograph will stimulate further interest in this relatively less known group of organisms.

Y. N.

**Common Cultivated Crops of South India.** By V. T. Subbiah Mudaliar. [Amudha Nilayam (Private) Ltd., Madras.] Pp. xvi + 606. Price Rs. 15.

The author of this well written book is a retired officer of the Madras Agricultural Department who, with his experience of 30 years spent as an executive officer in the districts of Madras and Andhra and as a Professor in the Agricultural Colleges of the two States, can be expected to do justice to the subject. The book, written in simple, lucid

style, should prove useful to students of agriculture in the schools and colleges of South India, and also appeal to the larger circle of enlightened farmers.

The first four chapters on soil and climate, tillage, manuring and irrigation are intended to give an introduction to the basic aspects of crop husbandry, an understanding of which is essential for getting maximum returns. The other 11 chapters are devoted to a detailed consideration of the agriculture of crops classified according to the nature of the produce obtained. Certain crops have been dealt with in more detail than others on account of their importance or of the diversity in the cultivation practices obtaining in different regions. Special problems of topical interest, like the Japanese method of rice cultivation, have been discussed. Where relevant, the author has also included information on the manufacture into the finished product as in the case of sugarcane and tobacco.

The chapter on green manures should be particularly welcome to cultivators. It explains the purposes and principles behind the practice of green manuring. It is no exaggeration to say that the average farmer in Madras has become green-manure conscious in recent years thanks to the drive of the Agricultural Department. The book abounds in statistical information on acreages and yields, and is illustrated with many neatly executed line drawings and photographs. Appendices pertaining to improved varieties of the more important crops have been given, though one feels that these include at least a few varieties which are obsolete or out of cultivation, and at best have only a historical significance to the student and the cultivator.

One misses accounts of orchard crops and vegetables, plantation crops and others like betel vine and cashew nut which are commonly grown by the cultivator. The inclusion of plant protection measures against the more important pests and diseases will be pertinent in the modern context when many of these have come into general agronomic routine. A few minor errors are evident in the subject-matter, as for example, in the accounts relating to potato and sugarcane but these do not detract from the value of the publication, and the author will no doubt rectify them when called upon to issue a second edition. Certain incorrect or loose terms have been employed, e.g., '*Bacilli* called *Bacilli radicola*' (p. 199), 'yam is a vinous plant' (p. 350), 'sugarcane sets are pickled in copper fungicidal solutions.....' (p. 370). Some errors of spelling attributable

perhaps to defective proof-reading are also seen, e.g., *Zingiber officinalis* (p. 424), *Eriodendron enfructosum* (p. 444), *Grevilla* (p. 444). An index and a more extensive bibliography will enhance the value of this useful publication.

N. L. DUTT.

**Trace Elements in Human and Animal Nutrition.** By E. J. Underwood. (Academic Press), 1956. Pp. vii + 430. Price \$ 9.50.

While many books on vitamins have been published in recent years, only a few have so far been written on trace elements even though they are as important as vitamins in human and animal nutrition. Monier William's book on 'Trace Elements in Food', published in 1949, is concerned principally with analytical methods and with toxicological and public health aspects of trace elements. The book under review, written by E. J. Underwood of Australia, is perhaps the first of its kind dealing with trace elements from the point of view of their nutritional significance to man and domestic animals and birds.

This publication consists of thirteen chapters and in the introductory chapter, the author has traced the development of the trace element concept from a historical standpoint and has also discussed the mode of action of trace elements and interactions among them. Then the author devotes a chapter each to the following elements: iron, copper, molybdenum, cobalt, nickel, zinc, manganese, iodine, fluorine and selenium. In the last two chapters, the author has dealt with aluminium, arsenic, barium, boron, bromine, silicon, strontium and vanadium and with soil-plant-animal interrelationships. Nutritional aspects have been emphasised throughout, although at various places, the biochemistry, pathology and toxicology of these elements, particularly in relation to animals and birds of economic importance, have been considered in great detail. On the whole it may be said that a balanced treatment of each element has been presented dealing first with the historical background, then the distribution, absorption and excretion together with manifestations of deficiency or toxic symptoms. Also interrelationships between trace elements and their nutritional significance have been stressed at various places. Perhaps, the value of this book could have been enhanced by including briefly details of one method of choice for the determination of each element before giving the data on distribution. The last chapter on soil-plant-animal interrelationship is

very interesting to read and gives much food for thought to the investigators in this field.

The get-up of the book is excellent and though priced high, scientists interested in human and animal nutrition will undoubtedly welcome it as a very valuable publication on trace elements.

P. S. SARMA.

**Advances in Carbohydrate Chemistry, Vol. 9.** (Academic Press Inc., New York), 1955. Pp. xviii + 426. Price \$ 10.50.

The volume begins with a brief biography of the late Prof. C. S. Hudson who played a very important part in the field of carbohydrate chemistry for nearly fifty years. R. U. Lemieux has given a stimulating account of the application of modern ideas on neighbouring group participation and shapes of organic molecules to replacement reactions encountered in carbohydrate chemistry. The chapter on paper chromatography of carbohydrates and related compounds will be of value not only to sugar chemists but also to biochemists and organic chemists interested in plant products. Chapters on alkali-sensitive glycosides, 2-hydroxyglycalz, the raffinose family of oligosaccharides, the methyl ethers of hexuronic acids and the conjugates of D-glucuronic acid are of great value to specialists in the field. The chapters on colour and turbidity of sugar products and on carboxymethylcellulose should interest carbohydrate chemists in industry. Needless to say, Volume 9 maintains the same high standard of scholarship and technical excellence of the earlier volumes.

T. R. GOVINDACHARI.

**Qualitative Organic Analysis and Scientific Method.** By A. McGookin. (Chapman & Hall, Ltd.), 1955. Pp. vii + 155. Price 15 sh.

The author writes with passionate zeal on organic qualitative analysis, which he believes to be an excellent means of instilling the principles of scientific method into students of chemistry. Since there is no systematised procedure for the analysis of organic compounds, the student has to depend in great measure on his background knowledge of organic chemistry, draw up a plan of work on the basis of initial tests, experiment, observe and come to conclusions. Teachers in charge of qualitative organic analysis know only too well how students go completely off the track as a result of incorrect observation based on some preconceived notion. The author, an experienced teacher, has laid bare the pitfalls encountered in organic analysis and the correct

method of approach in analysing an unknown organic compound. Teachers and students alike will benefit by a perusal of this book. The book, however, is not self-contained since there are no tables of physical constants of organic compounds.

T. R. GOVINDACHARI.

#### Books Received

*Progress in Nuclear Energy*, Vol. II. (Reactors).

Edited by R. A. Charpie, D. J. Littler, D. T. Hughes and M. Trocheris. (Pergamon Press, London), 1956. Pp. x + 492. Price 100 sh.

*An Introduction to Modern Organic Analysis.*

By Sidney Siggia and Hans J. Stolten. (Interscience Pub.), 1956. Pp. vii + 250. Price \$ 4.50.

*Antibiotics Monographs*, No. 6. [Terramycin

(Oxytetracycline)]. By Marle M. Musselman. (Interscience Pub.), 1956. Pp. 144. Price \$ 4.00.

*Coimbatore Canes in Cultivation*, Second Edition.

By N. L. Dutt and J. Thuljaram Rao. (The Indian Central Sugarcane Committee, 20, Rohtak Road, New Delhi), 1956. Pp. 125. Price Rs. 25.

## SCIENCE NOTES AND NEWS

### *Plectropoma maculatum* Bloch. in Indian Sea

Dr. (Miss) Mary Chandy, Department of Zoology, University of Delhi, observes that a perch-like fish of the genus *Plectropoma* was caught in March 1948, off the coast of Malwan, south of Bombay, by the Indian Fisheries Company, Ltd., Bombay. It has been identified as *Plectropoma maculatum* Bloch. It measured 577 mm., and is now deposited in the Central Marine Fisheries Collection.

The species has been recorded so far from Malay Archipelago, Red Sea, East Coast of Africa, Ceylon, China, Japan and Australia (Weber & de Beaufort, *Fish. Indo-Austral. Archip.*, 1931, 7, p. 77). Its appearance in the Arabian Sea is recorded for the first time, indicating that its range of distribution extends to the West Coast of India also.

### Experiments with Weightlessness

The effects of being without weight for a prolonged period cannot be determined until man actually goes out into space. But Dr. S. J. Gerathewohl, of the United States School of Aviation Medicine, has been able to produce weightlessness in the occupants of an aircraft for periods of up to 45 seconds.

After a preliminary dive to gain speed, a Lockheed T-33 was made to follow a parabolic arc such as would be described by a stone flung to a height of 20,000 feet using at the same time just enough engine power to overcome air resistance. The same pilot flew throughout the experiment, and 16 subjects, all with previous flying experience, were taken up in turn as passengers, each for several flights, usually held in by harness but sometimes letting them-

selves float free. All were asked to record their sensations. Surprisingly enough at least half the subjects found the sensation enjoyable; as one of them put it: "I've never been so comfortable in all my life, and I think that if I had my choice of places to relax, a weightless condition would be definitely it."

Another group found the sensations merely tolerable, while a quarter of the whole number suffered from motion sickness. No one can be certain that these findings would still apply if weightlessness were extended to longer periods, but it is interesting to learn that it is not a distressing condition to many.

### International Cloud Atlas

The World Meteorological Organisation announces that the various volumes of the *International Cloud Atlas* are nearing completion and will be available shortly for distribution. Volume I (price \$ 2.35) is a comprehensive text containing a detailed descriptive study of clouds and meteors, and of the techniques of observing and reporting them, both by surface and by air-borne observers. Volume II (price \$ 4.45) is a collection of 224 plates, 121 in black and white and 103 in colour, the object of which is to illustrate the text of Volume I. These photographs, some taken from the earth's surface and some from aircraft, depict many different kinds of clouds and certain of the atmospheric meteors. Each plate contains a legend which describes the important features in the photograph and explains how to identify and code the clouds represented. The volume concludes with two appendices designed to assist the reader in finding a particular illustration speedily.

An abridged edition of the *International Cloud Atlas*, an album specially intended for the use of pilots and air-borne observers, and bare plates for the benefit of meteorological services and others also will also be available.

#### XIVth International Conference on Tuberculosis

The XIVth International Conference on Tuberculosis under the auspices of the International Union against Tuberculosis and the Tuberculosis Association of India will be held in New Delhi from the 7th to 11th January 1957. This will be the first International Congress on Tuberculosis to be held in the East.

The principal questions to be discussed during the Conference are: Diagnostic and biological problems of isoniazid-resistant tubercle bacilli; clinical and epidemiological results of ambulatory chemotherapy in pulmonary tuberculosis; and the incidence of tuberculosis in economically under-developed countries and the methods for evaluating it.

Symposia on the following subjects have been arranged: value of tuberculin reactions for the selection of cases for B.C.G. vaccination and significance of post-vaccination allergy; the importance of nutritional factors in tuberculosis; cortisone in the treatment of tuberculosis; and the role of voluntary tuberculosis associations in tuberculosis control programmes.

#### Magnetic Crystals by Hydrothermal Method

According to a report by the Office of Technical Services, U.S. Department of Commerce, magnetite crystals have been successfully grown at a rate of 0.05 millimetre per day by a hydrothermal process. Growth occurred in steel autoclaves containing ammonium chloride solution. Temperature at the top of the chamber, where the crystals grew, was 430° C. and at the bottom 480° C. Pressure was about 22,500 pounds per square inch. Growth rate decreased with lower temperatures and pressures and practically stopped at about 400° C. and 15,000 pounds per square inch.

Among various aqueous media used, only ammonium chloride promoted crystal growth through a hydrogen-producing reaction to steel alloys in the pressure vessels. The specific function of the solution is not yet clear. Evidence showed that the growth was the outcome of a chemical process, and not of recrystallisation of the parent material from a supersaturated solution. Although experimentation was primarily with magnetite, it is believed that the

process may be applied to production of other ferrites.

#### Role of History of Science

The Indian Society for the History of Science is organising a symposium on the role of history of science at the forthcoming session of the Indian Science Congress Association at Calcutta. The following have agreed to participate, and read the papers on the subject noted against their names: Dr. D. S. Kothari—Value of History of Science in General Education; Professor R. C. Mazumdar—Role of the History of Science in the Study of Ancient Culture; Professor P. Ray—Teaching of Chemistry on the Historical Background; Professor S. N. Hassan—Role of the History of Science in the Teaching of History.

Those desirous of participating may communicate the title of their paper and a brief abstract, not more than 400 words to the Secretary: Dr. A. Rahman, Regional Research Laboratory, Hyderabad-9.

#### Storing Molecular Fragments

The National Bureau of Standards has developed a technique for capturing and storing large numbers of highly reactive molecular fragments at temperatures near absolute zero. In this method, unstable atoms and free radicals, known to exist but momentarily in flames and hot gases, are produced in an electric discharge, frozen into immobility, and trapped in solid form. Because these atoms are frozen in the excited state, they can be conveniently studied by optical spectroscopy.

In experiments to date, the Bureau has produced solids containing atomic nitrogen and oxygen, and possibly atomic hydrogen and an unstable hydroxy (OH) molecule. These solids have very unusual properties, emitting bright glows, blue "flames", and coloured flashes of light. When warmed 20° or 30°, they combine very actively, releasing large quantities of stored energy, principally as heat. Possible fields of application for this new method include studies in solid state physics and basic chemistry, in which the trapped atoms could be used as powerful probes into the solids containing them.

#### University Research in the Soviet Union

The role of Universities in research in the Soviet Union is undergoing a major change, according to the *New York Times*. The Soviet Government has ordered the transfer of a number of research institutions from the control

of the Soviet Academy of Sciences to that of the Universities. The Ministry of Higher Education, which controls the Universities, will compile a plan that will stipulate the most important areas for research. It is expected that Universities will work on automaton of production, development of semi-conductors, the application of oxygen to metallurgy, the chemistry of radioactive substances, nuclear physics, machine tool design, the increase of crop yields and so on.

#### List of Indian Fungi

A List of Indian Fungi: 1952-56, by C. V. Subramanian and K. Ramakrishnan, has just been published in *J. Madras Univ.*, B, 1956, 26, 327. This list brings together records of Indian fungi including new taxa proposed during the period 1952-56 and follows the same format of the authors' previous list (*J. Madras Univ.*, B, 1952, 22, 163), which covered the period, 1938-52. Following a brief resume of the Indian work during the period, the fungi are listed alphabetically under genera, together with full citation of literature. A list of host genera and substrata, a list of basonyms of the fungi listed as well as some obligate and facultative synonyms, and a systematic arrangement of the genera are appended.

#### Botanical Research Institute in Kashmir

The Government of Jammu and Kashmir have set up an organization for pathological survey and botanical research in the State. The scheme which forms part of the State's Second Five-Year Plan, includes survey of and investigation into diseases of forest trees, decay of timber and forest fungi; diseases of fruit and avenue trees; diseases of crop plants; and die-back of mulberry trees in the plantations in the State.

The Scheme also provides for organization of botanical studies, research and expansion in co-ordination with the University of Jammu and Kashmir, and envisages the establishment in Srinagar of a National Park or Botanical Garden and Arboretum representing economic plants of Western Himalayas and of the State; a Botanical Museum; and a Herbarium representing the flora of North and North-Western India to facilitate the study of plant science in the Jammu and Kashmir University.

The Botanical Research Institute will conduct surveys and investigations in co-ordination with the Forest, Agriculture and Sericulture Departments.

Dr. K. Bagchee, ex-mycologist, Forest Research Institute, Dehra Dun, has been appointed Director, Botanical Research, Jammu and Kashmir.

#### The Corday-Morgan Commonwealth Fellowship

Applications are being invited from citizens of any country within the British Commonwealth for The Corday-Morgan Commonwealth Fellowship for Post-Doctorate (or equivalent) study in any branch of Chemistry. It will be tenable for one year in some part of the British Commonwealth other than that in which the candidate received his scientific education, at any University, research institution, or other place of study approved by the Corday-Morgan Memorial Fund Executive.

The value of the Fellowship will be £ 700 per annum, but additional allowances may be granted in appropriate cases for travel, University fees, etc. The appointment will date from the 1st October 1957, or such other date as may be arranged.

Application forms and copies of the General Regulations governing the Award may be obtained from: The Secretary, Corday-Morgan Memorial Fund Executive, C/o The Chemical Society, Burlington House, London, W.1. Applications must be received by the Secretary not later than 1st March 1957.

#### Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Geophysics to Sri. A. A. Rama Sastry for his thesis entitled, "Some Aspects of the Physics of the Atmosphere and the Sea; and the D.Sc. Degree in Chemistry to Sri. V. Panduranga Rao for his thesis entitled, "Photochemical Analysis: Newer Methods for the Estimation of Uranium."

The Annamalai University has awarded the Ph.D. Degree in Chemistry to Kumari A. A. Aleykutty for her thesis entitled, "Preparation of Sulphones by the Fries and Friedel-Crafts Reactions and a Spectroscopic Study of the Internal Hydrogen Bond in *o*-Hydroxy Sulphones."

The Osmania University has awarded the Ph.D. Degree in Physics to Messrs. K. Ramavaram, V. T. Deshpande and T. S. Narasimhamurthy for theses entitled, "Studies in Chelation by Raman Effect", "X-Ray Studies of Temperature Variation of Lattice and the Coefficients of Thermal Expansion", and "Photo-elasticity of Crystals" respectively.

# Current Science

Vol. XXV]

NOVEMBER 1956

[No. 11

	PAGE		PAGE
<i>The Scientific Value of Artificial Satellites</i>	345	<i>Obituary—Prof. B. M. Das (1886-1956)</i> ..	352
<i>1956 Kalinga Prize Award to Prof. George Gamow</i> .. .. .	347	<i>International Atomic Energy Agency</i> ..	352
<i>A New Method for the Structure Analysis of Non-Centrosymmetric Crystals—</i>		<i>Letters to the Editor</i> .. .. .	353
G. N. RAMACHANDRAN AND S. RAMAN ..	348	<i>Reviews</i> .. .. .	370
<i>Second Congress on Theoretical and Applied Mechanics</i> .. .. .	351	<i>Progress in Nuclear Energy Reactors—</i>	
		S. B. D. IYENGAR .. .. .	374
		<i>Science Notes and News</i> .. .. .	375

## THE SCIENTIFIC VALUE OF ARTIFICIAL SATELLITES\*

THE satellite programme of the U.S.A. forms part of its contribution to the International Geophysical year 1957-58, and the Department of Defence has been assigned the major task of setting up a satellite into an orbit round the earth, as well as proving that they have done so. It is intended to put up into a satellite orbit a hollow sphere weighing 21½ lb. and with diameter of about 20 in. It should also be a good reflector, for a mirror-like surface is desirable on the satellite so that it can be observed optically. The launching will probably be done with three-stage rockets. The first stage, which drops off, will be very large, comprising most of the mass and weighing something like 20,000 lb. It will go up to an altitude of about 40 miles, with a velocity of about 4,000 miles per hour, and then fall off.

The second stage will continue on upward to about 130 miles; the last stage will carry the small 21 lb. satellite into an orbit with a velocity of about 18,000 miles per hour. It will revolve once around the earth in some 100 minutes. The plan is to put it into an orbit so that its minimum distance from the earth is 200 miles and the maximum, 800 miles.

Launching will take place from the Patrick Air Force Base at Point Canaveral, Florida, U.S.A., such that the satellite travels in an orbit inclined 28° or more to the earth's equator. Thus, as it goes around the earth it will pass over all latitudes between 28° N. and 28° S. Also it is intended to make six 'earnest' tries, and it is hoped that perhaps half of them will be successful. Then the IGY hopes to send up six more, making a dozen attempts all together; possibly no two of the satellites will be alike.

With a view to ascertain whether the satellite is really up there in the orbit, a small transmitter operated by super batteries will be put inside each satellite. This transmitter will probably operate on 108 megacycles per second

\* Based on a lecture by Dr. Fred L. Whipple, Director, Smithsonian Astrophysical Observatory, Cambridge, Mass., summarising the proceedings of the symposium on 'Earth Satellites as Research Vehicles' held at the Franklin Institute, and reported in their *Journal* (1956, 262, 95). A preliminary report on U.S. Satellite Programme appeared in an earlier issue of *Curr. Sci.* (1956, 25, 45).

(about 3 metres wavelength). The weak signals, of the order of milliwatts, can be picked up by very large antennas on the ground every time the satellite comes within 600 miles, and even be used to locate it to an accuracy of the order of a minute or two of arc.

Even if the electronic system fails, the satellite can be sighted by its reflected light from ground observing stations under the direction of Smithsonian Astrophysical Observatory. This has to be done with considerable care and at the right time, for the only time when the satellite can be seen in the twilight period when the satellite is more or less overhead and the sun has already set a bit below the horizon so that the sky is not too bright. At such times, a 20 in. sphere at a minimum distance of 200 miles will be just brighter than the 6th magnitude, which is the theoretical limit of the naked eye. This means that it does not take much optical aid; binoculars, for example, will do for a lay observer to observe it, provided he knows where to look and when.

One important aspect of this programme is the organisation of the non-professional astronomers and other interested observers into groups so that they can systematically look for the satellite and help to find out what happened to it in case the transmitter system fails.† There is another time when amateur observations will be of extreme importance; that is when the satellite is about to come down. About this one cannot be certain to a degree of accuracy better than a factor of 3—possibly not within a factor of 10 even—since we have no exact data at present about the atmosphere at altitudes 200 miles and above. A reasonable estimate is, the satellite will stay up for a good many weeks and will start falling rapidly in about a year.

In any case, as the satellite falls into the atmosphere, the rate at which it comes down, or in other words, the resistance of the atmosphere, is a direct measure of how much air is up there. Simply by tracking the satellite round its orbit, one can determine the density of air at various heights up to approximately 300 miles. If in addition the composition of the air is also known, we could tell the temperature. Both are extremely important data about the very high atmosphere.

The problem of predicting where the satellite will be at any instant requires quite a performance from the computing machines, for predictions are needed about once every minute,

and even then hardly sufficient, because in a minute the satellite will have raced over nearly 300 miles.

The satellites are expected to add materially to our scientific knowledge and the equipment inside each satellite will measure some physical quantity, probably two or three. In the earlier ones there may be devices that will measure, for example, the noise when a meteor pings the surface of the satellite. These little dust-like particles are not big enough to make visual shooting stars before they get into the earth's atmosphere, but upon striking the surface of the satellite they will make a noise which can be picked up by a very sensitive microphone. Here, one would like to know how often a sphere like this will be punctured by meteors. The best way to get an answer is to put a little bit of air pressure in the satellite, then add a pressure measuring device, which will then give a record of the pressure in the sealed up sphere. If a little hole is punctured by a meteorite, the pressure will fall off and by measuring the rate of fall one can determine the size of the hole made, and eventually the number of such particles.

One observation which will certainly be made in one of the earliest satellites will be a measurement of cosmic rays. A major question which is not yet clearly resolved is whether some of the weaker cosmic rays come from the sun, or whether their variations with solar activity are caused by changes in the earth's or the sun's magnetic field. If we can get direct cosmic ray measures out in the satellite orbit, well above the dense part of the earth's atmosphere, then a great deal can be learnt about the origin of the cosmic rays and perhaps this will enable us to settle this particular problem. At the same time we can measure the number of hydrogen atoms which are being shot off continuously from the sun and which produce the Aurora Borealis when they strike the upper atmosphere.

Solar activity in the far ultraviolet, in fact, over all regions of the spectrum, can also be investigated. For, at present most of the far ultraviolet is being absorbed by the atmosphere, but if we can get above the atmosphere, all this radiation comes pouring into our measuring instruments. Then we can find out how the sun varies when it changes its light in the far ultraviolet and how it produces magnetic storms and the Aurora Borealis.

And then we can determine the shape of the earth provided the orbital path of the satellite can be ascertained to a high degree of accuracy. From this can be deduced quantities con-

† It is understood that an observing station will be set up in this country either at Delhi or Nainital.

cerning the gravity, the density of material, and isostasy, the plastic flow represented by the way continents spring back up after being depressed by ice in the Ice Ages.

There is also the very interesting problem of the radiation of the night sky about which the satellite may be made to tell us much. For, with very simple equipment up there, one can hope to distinguish among four different sources of night sky light: light from the upper atmosphere, light from the solar system, light from the Milky Way and light from the distant galaxies. It may also be possible with rather simple equipment to separate these sources in the far ultraviolet and in the near ultraviolet. Even in the visual region we could possibly determine some answers about cosmology. Are we living in a universe in which everything is blowing up and all the galaxies moving away? Are galaxies short-lived or, as some suggest, would the system always look the same whether we see it now or ten billion years in the past, or ten billion years in the future? We may be able to discriminate among some of those theories simply by measuring the amount of light in the background of the skyline, down to 5% or 10% level of the night sky brightness, the part that comes from the very distant galaxies at incredible distances into space.

Just a word or two about the future beyond this very first step that is being made. The satellites can be divided into classes by weight, starting off by say, a tenth of the one that is planned—a 2 lb. satellite, which is quite useless because one can never prove that it has been launched. When the order of about 10 lb. to 20 lb. is reached, a satellite object can be built which can, at least, be observed and in-

strumented to some extent. The next step, using more powerful rockets and with mastery of the technique, is to send up something about 10 times as heavy, say, 200 lb. At this stage, perhaps nuclear power supplies can be utilized, so that the power system will last for years, even decades or centuries. Or perhaps solar batteries can be used to transform solar radiation into electrical energy. Probably a transistorized television system can be included to take photographs from such a satellite.

The next step is perhaps the 2,000-lb. satellite, in which all of these things can be done better through the inclusion of a small physical laboratory. At about this size we come, not to the manned rocket, but something near to the puppet-type rocket. A puppet remotely controlled from the earth by radio techniques, can do any of the useful things up there that man can do. Since the senses are useless in space except for sight and touch the puppet will need only television eyes and a feedback servomechanism to replace man completely.

Extremely valuable results in regard to meteorology and weather conditions can be expected when even the 200-lb. rocket becomes possible. This progress will complete the revolution in meteorology which is now under way in the form of mechanising the collection of data and the calculation of weather forecasts.

It is perhaps no exaggeration to say that the satellite programme is the most marvellous scientific development that has happened in recent years, and the programme derives added interest from the fact that the greatest scientific discoveries resulting from it will hardly be those anticipated.

#### 1956 KALINGA PRIZE AWARD TO PROF. GEORGE GAMOW

PROFESSOR GEORGE GAMOW, of the University of Colorado, has been awarded the 1,000 pounds sterling Kalinga Prize for his work in popularizing science. Previous winners of the prize have been Professor Louis de Broglie, 1952; Dr. Julian Huxley, 1953; Waldeemar Kaempffert, 1954; and Dr. August Pi Suner, 1955.

Prof. Gamow is well known for his researches on the theory of radioactive decay, relativistic cosmology and the origin of chemical elements, and the theory of protein synthesis. In particular, he is the discoverer of the celebrated

"Tunnel Effect" which explains, on the basis of wave mechanics, how electrically-charged particles can reach the nucleus of an atom.

Prof. Gamow is also famous as an author of books in the field of science popularisation which have been translated into twelve languages and in some cases published in Braille. They include "Theory of the Atomic Nucleus", "Mr. Tompkins in Wonderland", "Mr. Tompkins Explores the Atom", "Mr. Tompkins Learns the Facts of Life", "Birth and Death of the Sun", "1, 2, 3.....Infinity", etc. He is now working on "Matter, Earth and Sky".



## A NEW METHOD FOR THE STRUCTURE ANALYSIS OF NON-CENTRO-SYMMETRIC CRYSTALS

G. N. RAMACHANDRAN AND S. RAMAN

Department of Physics, University of Madras, Guindy, Madras-25

NO direct methods are available at present for the determination of the phases of structure factors of a single non-centrosymmetric crystal. If two isomorphous crystals are available and if the positions of the replaceable atoms (A) in the unit cell can be fixed, then the phases of the various reflections can be determined but for an ambiguity between two possible values. This ambiguity is in the sign of the phase  $\theta$  with respect to the phase of the contribution from the replaceable atom, say,  $\alpha_A(hkl)$ , so that the phase of the structure factor  $F(hkl)$  may be either  $\alpha_1 = \alpha_A + \theta$  or  $\alpha_2 = \alpha_A - \theta$ . In all the determinations made so far, the replaceable atoms are related by a centre of inversion so that the phase  $\alpha_A(hkl)$  is either 0 or  $\pi$  and so  $\alpha_1 = -\alpha_2$ . In such a case, if a Fourier synthesis is calculated using both  $\alpha_1$  and  $\alpha_2$ , then the resulting diagram will consist of the structure, duplicated by its inverse at the inversion-centre of the replaceable atoms. If the replaceable atoms do not have a centre of symmetry, then no simple relation exists between the Fourier synthesis calculated by using both  $\alpha_1$  and  $\alpha_2$  and the actual structure.

## DETERMINATION OF PHASE FROM ANOMALOUS DISPERSION

It is possible to obtain the phases directly, without the need for an isomorphous pair of crystals by making use of effects of anomalous dispersion. Suppose the crystal contains one atom or a set of atoms, for which the imaginary component of the scattering factor is appreciable, while for all the other atoms, this component is negligible. Such a situation occurs in a large number of organic

compounds, containing a halogen or sulphur or a metal atom, in addition to C, N and O. In such a case, it is possible to find the phase  $\alpha(hkl)$  with reference to the phase  $\alpha_A(hkl)$  of the anomalous scatterer.

Fig. 1 represents the various components of the structure amplitudes of a reflection  $hkl$  and its inverse  $\bar{h}\bar{k}\bar{l}$ . The latter are indicated by a bar over the symbols.  $F_A'$  is that part of the contribution from the anomalous scatterer which depends upon normal dispersion and  $F_A''$

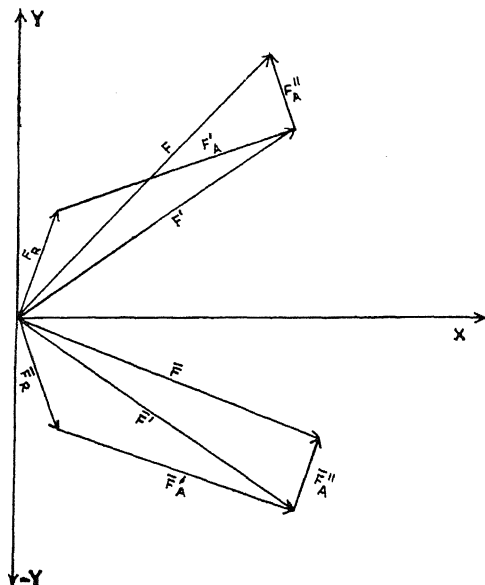
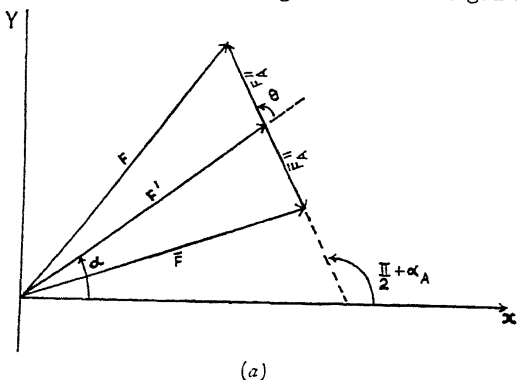
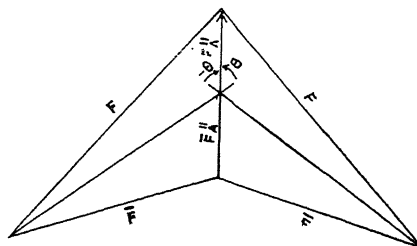


FIG. 1. Diagram showing the relationship between the various components of the structure amplitudes of reflections  $hkl$  and  $\bar{h}\bar{k}\bar{l}$ .

is the part which is produced by anomalous dispersion and  $F_R$  is the net contribution from all the other non-anomalous scatterers. The relationship between  $F$ ,  $F'$  and  $F_A''$  is particularly brought out in Fig. 2 where the vectors



(a)



(b)

FIG. 2. Relation between  $F$ ,  $\bar{F}$  and  $F_A''$

relating to  $\bar{h}\bar{k}\bar{l}$  have been reflected about the real axis. We have from this diagram, since  $\bar{F}_A'' = F_A''$  numerically,

$$F^2 = F'^2 + F_A''^2 + 2 F'F_A'' \cos \theta$$

$$\bar{F}^2 = F'^2 + F_A''^2 - 2 F'F_A'' \cos \theta$$

$$F'^2 = \frac{1}{2} (F^2 + \bar{F}^2) - F_A''^2$$

Thus

$$\Delta F^2 = (F^2 - \bar{F}^2) = 4 F'F_A'' \cos \theta$$

$$\text{and } \cos \theta = \Delta F^2 / 4 F'F_A'' \quad (1)$$

If  $F_A'' \ll F_A'$ , an approximate formula is

$$\cos \theta = \Delta F / 2 F_A'' \quad (2)$$

Here  $\theta$  is the angle made by the non-anomalous part of the structure factor with the anomalous part. The phase of  $F'$  is obviously  $\alpha = \pi/2 + \alpha_A - \theta$ , if all the anomalous scatterers are of the same type, e.g., all chlorines. If not, the phase angle  $\phi$  between  $F_A''$  and  $F_A'$  can be worked out from the known positions of the anomalous scatterers alone, and then

$$\alpha = \phi + \alpha_A - \theta$$

In the discussion below we shall confine ourselves to the former case when  $\phi = \pi/2$  and the extension to the more general case is obvious.

Experimentally therefore, if the difference in intensity of the reflection  $hkl$  and its inverse  $\bar{h}\bar{k}\bar{l}$  is measured accurately, then  $\Delta F^2$  can be calculated provided the scale factor is known.  $F_A''$  can be calculated from the atomic co-ordinates of the anomalous scatterers (which can be obtained in most cases from a Patterson synthesis) and the known imaginary component of their atomic scattering factors and therefore  $\theta$  can be obtained.

However, the solution for  $\theta$  from  $\cos \theta$  is ambiguous, since  $\theta$  can be either  $+\theta$  or  $-\theta$  and consequently the phase of  $F'$  determined in this way has the ambiguity given by

$$\alpha_{1,2} = \pi/2 + \alpha_A \pm \theta$$

This ambiguity is similar to the one occurring in the determination of phase by the isomorphous replacement method. In fact the scattering factor of the atoms A for the two reflections  $hkl$  and  $\bar{h}\bar{k}\bar{l}$  are effectively different and this is made use of in the determination of phase.

#### AMBIGUITY AND ITS RESOLUTION

If the group of anomalous scatterers is centrosymmetric, the phase angle  $\alpha_A$  is 0 or  $\pi$  and in this case, the two possible values of the phase of  $F'$  are  $\alpha_1 = \alpha$  and  $\alpha_2 = \pi - \alpha$ . It can be shown that if a Fourier synthesis is calculated using both the values of the phase, then the resulting

diagram would contain, in addition to the peaks of the real structure, an equal number of negative peaks, at positions related to the former by an inversion about the inversion centre of the replaceable atoms. This diagram is similar to what one obtains by performing a Patterson synthesis with  $\Delta F^2$  which has been utilised by Pepinsky and collaborators for the determination of absolute configuration.<sup>1</sup> However it is superior to the latter in that only one duplication of the structure occurs and this too in the form of negative peaks, while in the  $\Delta F^2$  Patterson, a series of images of the structure as seen from each of the atoms in the set A occurs and the whole series is duplicated in the form of negative peaks about the inversion centre.

#### EXPERIMENTAL VERIFICATION

The method has been tested in the case of ephedrine hydrochloride<sup>2</sup> in which there are two chlorine atoms per unit cell. Only  $\text{CuK}\alpha$  radiation was used and the anomalous dispersion of chlorine for this wavelength ( $\Delta f'' = 0.69$ ) was sufficient to give useful information. The difference in intensity between each pair of inverse reflections was measured accurately with a Geiger counter spectrometer for all the reflections of type  $hk0$  and the phases were calculated from expression (2). The measurements were put on an absolute scale by using the reported values of  $F_c$ . The values of  $\alpha$  as found by experiment are given in Table I together with the values of  $\alpha$  calculated from the structure determined by conventional methods. The agreement is seen to be good, the differences rarely exceeding  $20^\circ$ .

Of the two possible values, the one which is nearer to the phase of the chlorine atoms may be chosen for a preliminary synthesis and thus the ambiguity resolved. This assumption is seen to be valid in nearly 75 per cent. of reflections as may be seen from Table I. The phases of those reflections for which the contribution from the chlorine atom is zero are indeterminate and this is a defect of the method. Such reflections are small in number and this difficulty is present even in the isomorphous replacement technique.

#### COMBINATION OF THE NEW METHOD AND ISOMORPHOUS REPLACEMENT TECHNIQUE

An interesting possibility arises if a pair of isomorphous substances are available and the replaceable atoms are anomalous scatterers. This is possible for instance with hydrochlorides and hydrobromides

TABLE I

Measurement of anomalous dispersion effect for  $hk0$  reflections of ephedrine hydrochloride.  $\alpha_1$  and  $\alpha_2$  are the two possible values of the phase, and the one which agrees with the phase calculated from the structure is shown in heavy type. The tick mark indicates those reflections for which the correct phase angle is the one which is closer to the phase  $\alpha_A$  of the chlorines. The reflections for which the columns beyond the fourth are left vacant are those for which  $\theta$  is indeterminate, since  $F_A'' = 0$ .

$h$	$k$	$l$	$\frac{\Delta \sqrt{I}}{\sqrt{I}}$	$\Delta F = \frac{\Delta \sqrt{I}}{\sqrt{I}} \cdot F_c$	$2F_A''$	$\theta$	$\alpha_A$	$\alpha_1$	$\alpha_2 = \pi - \alpha_1$	$\alpha$ from structure	Validity of hypothesis
1	1	0	-0.055	-0.086	-2.02	62	180	28	152	61	✓
2	1	0	-0.052	-1.487	-2.76	57	180	33	147	158	✓
3	1	0	-0.012	-0.466	-1.88	76	180	14	166	174	✓
4	1	0	-0.010	-0.146	0.0	..	..	..	..	..	..
5	1	0	0.103	1.380	2.02	47	0	53	127	113	×
6	1	0	0.0	0.0	2.76	90	0	0	180	11	✓
7	1	0	0.005	0.028	1.88	89	0	1	179	4	✓
8	1	0	0.0	0.0	0.0	..	..	..	..	..	..
9	1	0	0.064	0.608	-2.02	108	180	342	198	225	✓
10	1	0	-0.046	-0.409	-2.76	82	180	8	172	168	✓
11	1	0	0.0	0.0	-1.88	90	180	0	180	175	✓
12	1	0	-0.016	-0.027	0	..	..	..	..	..	..
0	2	0	0.0	0.0	-2.76	90	180	0	180	174	✓
1	2	0	-0.025	-0.505	-1.88	74	180	16	164	153	✓
2	2	0	0.0	0.0	0.0	..	..	..	..	..	..
3	2	0	0.270	1.701	2.02	32	0	58	122	116	×
4	2	0	-0.068	-1.292	2.76	118	0	332	208	324	✓
5	2	0	-0.094	-0.686	1.88	111	0	339	209	325	✓
6	2	0	0.0	0.0	0.0	..	..	..	..	..	..
7	2	0	-0.067	-0.0549	-2.02	74	180	16	164	163	✓
8	2	0	0.0	0.0	-2.76	90	180	0	180	172	✓
9	2	0	0.023	0.276	-1.88	99	180	351	189	220	✓
10	2	0	-0.038	-0.251	0.0	..	..	..	..	..	..
11	2	0	-0.035	-0.200	2.02	95	0	355	195	351	✓
12	2	0	0.071	0.511	2.76	79	0	11	169	27	✓
1	3	0	-0.024	-0.451	2.02	103	0	347	193	349	✓
2	3	0	0.009	0.156	2.76	87	0	3	177	15	✓
3	3	0	0.026	0.354	1.88	79	0	11	169	10	✓
4	3	0	-0.025	-0.315	0.0	..	..	..	..	..	..
5	3	0	0.035	0.371	-2.02	101	180	349	191	194	✓
6	3	0	0.135	1.053	-2.76	112	180	338	202	242	×
7	3	0	-0.060	-0.378	-1.88	78	180	12	168	140	✓
8	3	0	-0.040	-0.484	0.0	..	..	..	..	..	..
9	3	0	-0.026	-0.086	2.02	92	0	358	182	146	×
10	3	0	-0.058	-0.551	2.76	101	0	349	191	329	✓
11	3	0	0.046	0.179	1.88	85	0	5	175	18	✓
0	4	0	0.046	0.497	2.76	80	0	10	170	22	✓
1	4	0	0.007	0.063	1.88	88	0	2	178	7	✓
2	4	0	-0.012	-0.046	0.0	..	..	..	..	..	..
3	4	0	0.218	0.523	-2.02	105	180	345	195	280	×
4	4	0	0.043	0.383	-2.76	98	180	352	188	179	✓
5	4	0	0.023	0.255	-1.88	98	180	352	188	202	✓
6	4	0	..	..	0	..	..	..	..	..	..
7	4	0	-0.270	-1.701	2.02	148	0	302	238	273	×
8	4	0	0.024	0.250	2.76	85	0	5	175	26	✓
1	5	0	-0.136	-1.006	-2.02	60	180	30	150	124	✓
2	5	0	-0.055	-0.798	-2.76	73	180	17	163	179	✓
3	5	0	-0.122	-0.598	-1.88	71	180	19	161	153	✓
4	5	0	-0.066	-0.277	0	..	..	..	..	..	..
0	6	0	-0.025	-0.228	-2.76	85	180	5	175	161	✓

of organic compounds. As already observed, the phase determination by isomorphous replacement is ambiguous. Detailed considerations<sup>3</sup> show that an unambiguous solution for the phases is possible by making use of a double replacement, i.e., when one has two other isomorphous compounds related to the compound under study in which two different groups of atoms are replaced. It is essential that the two groups of replaceable atoms are not centrosymmetric about the same point in the unit cell or about points differing by integral multiples of half the unit translations. Even if these conditions are satisfied, the ambiguity might still occur for some reflections.

The ambiguity in the sign of the phase angle with reference to the phase of the replaceable atoms can however be resolved if the isomorphous replacement method is used in conjunction with the new method. This is so because the latter gives the two values

$a_1 = a_A + \pi/2 + \theta$  and  $a_2 = a_A + \pi/2 - \theta$   
while the former gives

$$a_3 = a_A + \phi \quad \text{and} \quad a_4 = a_A - \phi$$

It is seen that one from each set should agree. Thus if  $a_1 = a_3$  the other two are always different, and the choice is obvious. The advantage of this combination is that it requires only one pair of isomorphous compounds, and in such cases, an unambiguous solution for the phase is always possible, irrespective of whether the replaceable atoms have a centre of symmetry or not.

The anomalous dispersion method of determining phases is now being used in the analysis of L-lysine hydrochloride in this laboratory.

1. Pepinsky, R. and Okaya, Y., *Proc. Nat. Acad. Sci. U.S.A.*, 1956, **42**, 286.
2. Phillips, D. C., *Acta Cryst.*, 1954, **7**, 159.
3. Harker, *Ibid.*, 1956, **9**, 1.

## SECOND CONGRESS ON THEORETICAL AND APPLIED MECHANICS

THE Second Congress on Theoretical and Applied Mechanics was held under the auspices of the Council of Scientific and Industrial Research on the 15th and 16th October 1956, at the National Physical Laboratory of India under the Presidentship of Dr. K. S. Krishnan, Director of the Laboratory. About eighty delegates were present including some from Germany, Japan, Poland and the U.S.A. Dr. J. C. Ghosh, Member, Planning Commission, who delivered the inaugural address, expressed the hope that the Indian society would soon establish direct contact with the International Union of Theoretical and Applied Mechanics. He also discussed the construction of a suitable model for the separation of diffusion and kinetic processes in gaseous catalytic reactions.

Dr. Krishnan in his presidential address explained the part played by the polarisation field in determining the observed resonance frequencies of the medium with particular reference to alkali-halides where the dispersion of the dielectric constant may also be regarded as exercised indirectly through its influence on resonance frequencies. Dr. P. Nilkantan gave a technical talk on 'The Origin of Ripples on Sand and Allied Phenomenon' where he sug-

gested that the wave pattern was not due to 'saltation' of sand particles, but corresponded to the hydrodynamical effect of a fluid moving over another highly viscous fluid.

The Congress received eighty-six communications from many parts of the world including China, Czechoslovakia, Egypt, Japan, Poland, U.S.S.R. and the U.S.A. Forty-eight of these were presented before the Congress relating broadly to finite deformation, elasticity theory, vibration and stability, fluid flow, heat-transfer, ballistics and statistics.

The Society accepted an invitation to hold the Third Congress in October-November 1957 at the Indian Institute of Science, Bangalore. Dr. S. R. Sen Gupta, Director, Indian Institute of Technology, Kharagpur, was elected President for the sessions 1957-59.

The following other Office-bearers were elected: *Vice-Presidents*: Sri. V. Cadambe and Prof. N. R. Sen; *Secretary-Treasurer*: Prof. B. R. Seth, Indian Institute of Technology, Kharagpur; *Members of the Council*: Sri. C. V. Joga Rao, Dr. G. P. Chatterjee, Prof. B. M. Belgaumkar, Dr. S. K. Roy, Dr. Ram Ballabh, Prof. V. Lakshminarayan, Sri. S. Krishnan, Dr. K. L. Rao and Dr. A. K. Gayen.

## OBITUARY

PROF. B. M. DAS (1886-1956)

WE regret to record the death of Prof. B. M. Das, Director, Central Leather Research Institute, Madras, due to heart failure on September 5, 1956.

*Rai Bahadur* B. M. Das was born in 1886 in Faridpore. He took his M.A. Degree examination in chemistry from the Presidency College, Calcutta University, obtaining the first rank. He carried out research initially on the Chamber Process for the manufacture of sulphuric acid, under Sir P. C. Ray, and was the first to put commercial sulphuric acid manufactured by an Indian firm on the market. Later he proceeded to Leeds University to study leather technology, and obtained the M.Sc. Degree in applied chemistry of leather manufacture. He worked for some time in a big commercial tannery in Milan and for two years served as technical chemist with *Farbenfabriken Friedrich Bayer & Co.*, in Germany.

On his return to India he joined the National Tannery in Calcutta where he worked as its Manager for about twenty-four years, modernising and expanding the tannery. While there, he was instrumental in establishing the Bengal Tanning Institute under the Government of Bengal. In recognition of his services to the leather industry, the Government of India awarded him the title of *Rai Bahadur* and also the Silver Jubilee Medal.

Prof. Das was appointed Chairman of the Leather Panel by the Government of India in 1944, and two years later he went to Germany as Technical Investigator of the German Tanning Industry under the British Intelligence Objectives Sub-Committee (B.I.O.S.). He also visited U.S.A. and U.K. to study the tanning industries in these countries. He was appointed by the Government of West Bengal as its adviser on leather and tanning, and in this

capacity, he carried out work at the Bengal Tanning Institute on the adaptation of German processes for the improvement of the Indian leather industry.

The technical reports published by him on these occasions contain valuable information on modern European and American processes of leather manufacture and the manufacture of leather auxiliaries. Besides these reports, he published a large number of bulletins and articles on leather research and leather technology. His book entitled *Handbook of Tanning* published by Government of Bengal as Department of Industries Bulletin No. 63 has had a wide appreciation and has passed through three editions. He has trained a large number of students in leather technology who are at present holding responsible posts in leather industry all over India, Burma and Ceylon.

From 1948 to 1951, he was appointed as Industrial Adviser on Leather and Tanning by the Government of West Bengal, and in September 1951 his services were requisitioned by the Council of Scientific and Industrial Research as Officer on Special Duty, Central Leather Research Institute, Madras. He was appointed as Director of the Central Leather Research Institute in January 1953 in which capacity he rendered valuable service to leather trade and industry till his demise in harness.

Prof. Das was also Hon. Professor of Leather Technology and Chairman of the Faculty of Technology, University of Madras, from 1954 onwards, and was associated with several of the committees connected with leather trade and industry: Leather Research Committee of the Government of India, Hides and Skins Committee of the Indian Council of Agricultural Research and the Leather Section Committee of the Indian Standards Institution.

## INTERNATIONAL ATOMIC ENERGY AGENCY

SEVENTY nations last month signed the statute of the International Atomic Energy Agency at the concluding session of a 4-week Conference organized by the United Nations in New York. In his closing speech, Joao Carlos Muniz of Brazil, President of the Conference, emphasized that there was nothing compulsory in the relationship between Member States and the Agency, and that the Agency will not impose complete international con-

trol over nuclear fuels or source materials. It would be a free association of nations to bring the benefits of atomic progress to all peoples. The new atomic era, he affirmed, would have much wider consequences than the first industrial revolution. Nuclear materials made available by members of the Agency will be used in agriculture, medicine and for other peaceful purposes.

## LETTERS TO THE EDITOR

	PAGE		PAGE
<i>Inertial Frames and the Form of an Equation of State of Thermodynamic Systems</i> —MOHD. SAMIULLAH ..	353	<i>Sex Mechanism in Dysdercus (Pyrrhocoridae—Heteroptera)</i> —G. P. SHARMA	360
<i>Force Constants of Some Radicals of XY<sub>n</sub> Type</i> —K. VENKATESWARLU AND S. SUNDARAM ..	354	<i>Macronuclear Reorganisation in Diophrys appendiculata (Ciliata hypotricha)</i> —P. N. GANAPATI AND M. V. NARASIMHA RAO ..	360
<i>Action of Tartaric Acid on Brass</i> —A. K. M. TRIVEDI AND M. N. DESAI ..	354	<i>A New Shipworm from Tondi, South India</i> —N. BALAKRISHNAN NAIR AND O. N. GURUMANI ..	361
<i>Use of a Coarse Grating to Find the Wavelength of High Frequency Sound Waves in a Liquid</i> —GOPALA MENON, SREEKANTATH ..	355	<i>Occurrence of Intra-Nuclear Neurosecretory Matter in the Tadpoles of Rana hexadactyla Lesson</i> —K. VIJAYAPRASAN-THAN PILLAY ..	362
<i>Infrared Spectrum of Orthofluorobromobenzene</i> —S. L. N. G. KRISHNAMACHARI	355	<i>Some Observations on the Cytology and Anatomy of Hypodermatium crenatum (Forsk.) Kuhn</i> —P. N. MEHRA AND D. S. LOYAL ..	363
<i>N:N'-Dialkylethylene Diamine Salts of Penicillin G</i> —G. N. VYAS AND S. G. DHOPATE ..	356	<i>Occurrence of Megaspores in the Coal from the South Rewa Gondwana Basin</i> —S. K. GOSWAMI ..	365
<i>Some Reactions of Pongamol</i> —CH. BHEEMASANKARA RAO AND V. VENKATESWARLU ..	357	<i>Three Undescribed Species of Xanthomonas</i> —M. C. SRINIVASAN AND M. K. PATEL ..	366
<i>Rauwolfia Alkaloids in Avian Malaria (P. gallinaceum)</i> —R. RAMA RAO AND M. SIRSI ..	357	<i>Crystalline Components of Certain Indian Pines</i> —Y. K. AHLUWALIA, ISHWAR DASS AND A. C. MEHTA ..	367
<i>Half-Wave Potentials and Atomic Characteristics</i> —D. V. N. SARMA AND BH. S. V. RAGHAVA RAO ..	358	<i>Neurosecretory Pathways in Calotes versicolor</i> —K. R. PANDALAI ..	368
<i>Rare-Earths: Polarographic Behaviour and Electronic Configurations</i> —D. V. N. SARMA AND BH. S. V. RAGHAVA RAO ..	358	<i>Occurrence of Heterosporium Disease of Garden Nasturtium in India</i> —B. L. CHONA AND J. N. KAPOOR ..	369
<i>Isolation of Three Crystalline Substances from the Seeds of Cassia tora Linn.</i> —C. S. NARAYANA AND S. RANGASWAMI ..	359		

### INERTIAL FRAMES AND THE FORM OF AN EQUATION OF STATE OF THERMODYNAMIC SYSTEMS

CONSIDER two observers S and S<sup>0</sup> who are in uniform relative motion with respect to each other. If the temperature of a system measured by the two observers are T and T<sub>0</sub>, Tolman<sup>1</sup> has shown on the basis of special relativity that

$$T = T^0 \beta \quad (1)$$

where  $\beta = \sqrt{1 - \frac{v^2}{c^2}}$ , v being the relative velocity of S and S<sup>0</sup> and c the velocity of light. From relativistic mechanics, it is also known that the following relations exist between pres-

sure (P, P<sub>0</sub>) and volume (V, V<sub>0</sub>) of a system as measured in S and S<sup>0</sup> respectively:

$$P = P^0 \text{ and } V = V^0 \beta \quad (2)$$

If we postulate that the product of pressure and volume of a thermodynamic system is a function of its temperature only, we can write

$$P^0 V^0 = F(T^0) \quad (3)$$

According to the special theory of relativity, all physical phenomena are governed by laws which have the same form in all systems which are in uniform relative motion to each other. Hence we can write a similar equation for the system S also:

$$PV = F(T) \quad (4)$$

Substituting the relations for P<sup>0</sup>, V<sup>0</sup>, T<sup>0</sup> in

terms of P, V and T from (1) and (2) in equation (3), we have

$$\frac{PV}{\beta} = F\left(\frac{T}{\beta}\right) \quad (5)$$

or

$$PV = \beta F\left(\frac{T}{\beta}\right) \quad (6)$$

Comparing this with (4) we obtain

$$F(T) = \beta F\left(\frac{T}{\beta}\right) \quad (7)$$

The unique solution of this functional equation is known to be  $F(T) = \alpha T$ , where  $\alpha$  is a constant. Hence we have  $PV = \alpha T$ , i.e., the product PV must be a linear function of the temperature in all systems.

Dept. of Physics, MOHD. SAMIULLAH.  
Mahboob College,  
Secunderabad, July 25, 1956.

1. Tolman, R. C., *Relativity, Thermodynamics and Cosmology*, Oxford, 1934, pp. 158-59.

### FORCE CONSTANTS OF SOME RADICALS OF $XY_6$ TYPE

THE Wilson's<sup>1</sup> F-G matrix method of analysis of molecular vibrations has been applied to the evaluation of the force constants of some radicals of  $XY_6$  type, from their Raman frequencies. The radicals discussed here have the octahedral symmetry  $O_h$  and give rise to three vibrations active in Raman effect. Of these, one is total symmetric ( $a_{1g}$ ), one is doubly degenerate ( $e_g$ ) and the third one is triply degenerate ( $f_{2g}$ ).

The potential function used in this investigation consists of four force constants  $f_d$ ,  $f_a$ ,  $f_{dd}$  and  $f_{aa}$  which have got the usual significance. The interaction force constant  $f_{da}$  has not been taken into consideration as the secular equations corresponding to the observed three frequencies do not contain  $f_{da}$ . The observed Raman frequencies in the case of the radicals discussed here and the force constants obtained from them are given in Table I.

TABLE I

Radical	Observed frequencies $\text{cm}^{-1}$			Force constants ( $10^5 \text{ dyne cm}^{-1}$ )			$X-Y$ in Å Badger's rule <sup>2</sup>
	$a_{1g}$	$e_g$	$f_{2g}$	$f_d$	$f_{dd}$	$f_a - 2f_{aa}$	
$\text{SiF}_6^{2-}$	646	466	403	1.902	0.237	0.901	1.61
$\text{SeCl}_6^{3-}$	346	273	166	1.294	0.109	0.288	..
$\text{SnCl}_6^{3-}$	320	235	158	1.143	0.127	0.261	2.52
$\text{SnBr}_6^{3-}$	183	144	69	0.704	0.060	0.112	..
$\text{SbCl}_6^{3-}$	337	277	172	1.640	0.199	0.310	2.30

Dept. of Physics, K. VENKATESWARLU.  
Annamalai University, S. SUNDARAM.  
Annamalainagar, August 6, 1956.

1. Wilson, E. B. Jr., *J. Chem. Phys.*, 1939, **7**, 1047; 1941, **9**, 76.
2. Couture-Mathieu, L. and Mathieu, J. P., *J. Phys. Radium*, 1951, **12**, 826.
3. Landolt-Bornstein, *Atom-und Molecular Physik*, Springer-Verlag, Berlin, 1951, 280.
4. Badger, R. M., *J. Chem. Phys.*, 1935, **3**, 710.

### ACTION OF TARTARIC ACID ON BRASS

DURING studies on corrosion in brass, a specimen of alpha brass (composition 67.3% Cu, 32.7% Zn) was exposed in a beaker containing 230 ml. of N/1000 tartaric acid solution, and it was found that after three days, a photographic impression of the patent mark on the beaker was formed on the surface of the brass plate (Fig. 1).

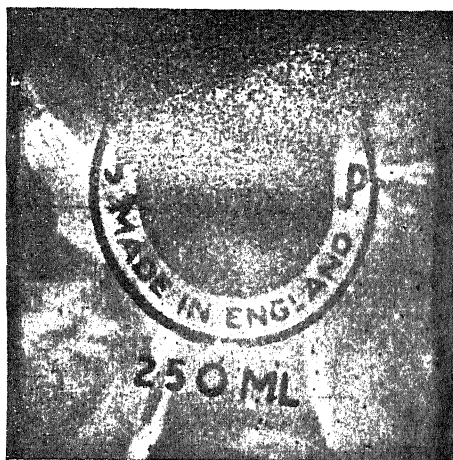


FIG. 1.

Specimens of area 6 cm.  $\times$  3 cm. cut accurately were used. Glass hooks were employed for suspension. A specimen piece of the alloy was first washed with distilled-water several times and then dried. It was then polished using successively 0 to 0000 Oakeys' emery papers. A mirror-like finish was obtained by polishing with jeweller's rouge.<sup>1</sup> The specimen was finally degreased by carbon tetrachloride. Tartaric acid of A.R. grade was used and the experiment was carried out at 33°C. After exposure, the specimen was cleaned with distilled-water, dried, weighed and photographed. To find out the loss on corrosion, the exposed plate was subsequently treated in a fresh beaker with 5% sulphuric acid.<sup>2</sup>

Experiments were performed with tartaric acid of various concentrations, from 0.001 N to 1.0 N. Only in 0.001 N was the formation of a photo-sensitive film noticed. In all other cases direct dissolution apparently takes place.

The film shows yellow, brown and bluish green colours. On testing with dilute sulphuric acid the film was blackened; dilute hydrochloric acid removed the film and there was a slight blackening at the sites of the film formation. Dilute ammonia had no effect. When a copper plate was similarly exposed a very faint image was obtained after three days.

Our thanks are due to Ahmedabad Education Society for laboratory facilities and the Gujarat University for the grant of a research scholarship to one of us (M. N. D.).

L. D. Arts College and A. K. M. TRIVEDI.  
M. G. Science Institute, M. N. DESAI.  
Ahmedabad-9,  
September 15, 1956.

1. Shaw, L. B. and Everdall, M. H., *J.C.S.*, 1942, 599.
2. Wiederholt, W., *Korrosionprüfverfahren*, 1945, Berlin, Verlagchemie.

# USE OF A COARSE GRATING TO FIND THE WAVELENGTH OF HIGH FREQUENCY SOUND WAVES IN A LIQUID

DIFFRACTION of light by high frequency sound waves traversing a liquid in an optical cell mounted on the table of a spectrometer, is utilised for finding the wavelength of sound waves  $\Delta$  in the liquid. The angles of diffraction of successive orders differ by  $\theta$  which is of the order of  $12'$  or less and an error of 10% is inevitable in the determination of that angle directly by means of a spectrometer, telescope and scale.

Considerable accuracy is obtainable, if a plane transmission coarse grating of accurately known spacing  $D$  is also employed in combination with the acoustic grating. Diffraction orders of both gratings are then seen when observed through the telescope of the spectrometer, on which the gratings are mounted, the acoustic grating on an independent platform and the other on the spectrometer table proper. Turning the table, say clockwise, the coarse grating is set at such an oblique angle of incidence  $i$  that the apparent spacing of the diffracted orders of the coarse grating becomes equal to that of the other, when exact coincidence between the two sets of different orders take place. Similar coincidence is ob-

tained in another position when the table is turned in the opposite direction. The angle between the two positions is  $2i$  which may be made to be of the order of  $60^\circ$  to  $90^\circ$ , when a proper value for  $D$  is chosen. The variation  $\delta i$  in the value of  $i$  for different measurements is not more than  $\frac{1}{2}^\circ$ .

In this case the wavelength of sound waves is given by  $\Delta = D \cos i$  and the error in its determination is  $\Delta = \Delta \tan i \delta i$  which is only about 0.5% when  $i$  is  $30^\circ$  and  $\delta i$  is  $\frac{1}{2}^\circ$ .

The author measured the wavelength of high frequency (7.5 Mc/s.) sound waves in water at  $30^\circ$  using a coarse grating  $D = 0.05$  cm., accurately ruled on silvered glass. The various values of  $2i$  when the second diffracted order of the coarse grating coincided with the first diffracted order of the acoustic grating, did not differ by even  $1^\circ$  and the average value was  $73^\circ 28'$  which yielded a value of  $\Delta = \frac{1}{2} D \cos i = 0.02004$  cm. for the wavelength of the sound waves in water. The velocity of the waves was found to be 1503 metres per second. Details of this work are being published elsewhere.

GOPALA MENON, SREEKANTATH.  
University College,  
Travancore University,  
Trivandrum, September 25, 1956.

## INFRARED SPECTRUM OF ORTHO-FLUOROBROMOBENZENE

IN continuation of the work on the ultra-violet absorption<sup>1</sup> and Raman effect<sup>2</sup> of ortho-fluorobromobenzene, the infrared spectrum of this compound has been studied. There is no previous report on the infrared spectrum of this molecule.

The spectrum is obtained with a Leitz infrared prism spectrograph equipped with Rock salt and potassium bromide optics. The liquid absorption spectrum in the Rock salt region is reported in the present communication. The spectrum is reproduced in Fig. 1.

About 90 bands are recorded and almost all of them are interpreted in terms of the fundamental frequencies shown in Table I. These fundamentals agree well with the Raman frequencies reported earlier.<sup>2</sup> The fundamentals marked with asterisks occur more frequently in the combination bands. The classification of the vibrations into planar  $a'$  vibrations and non-planar  $a''$  vibrations is partly aided by the state of polarisation of the corresponding Raman lines and the relative intensities in the infrared and Raman effect and by the magnitude of



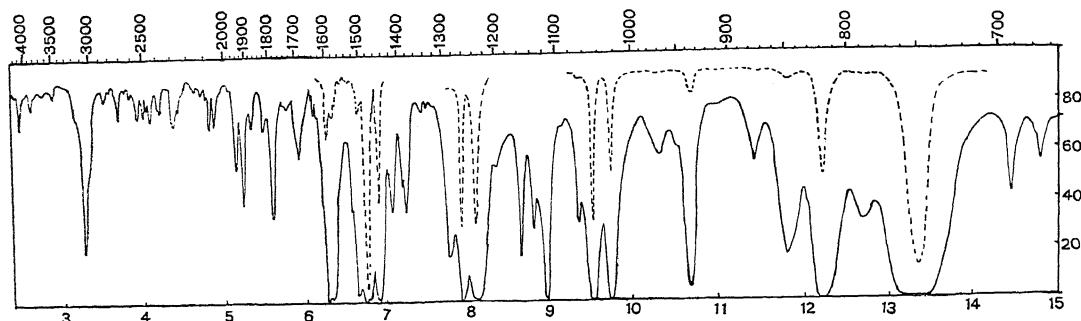


FIG. 1. Infrared spectrum of liquid ortho-fluorobromobenzene. (Solid curve—film thickness 0.09 mm.; dotted curve—capillary film.)

the frequencies compared to those of the ortho-fluorochlorobenzene (Nielsen).<sup>3</sup>

The author is grateful to Dr. G. C. Finger of the Illinois State Geological Survey for the gift of the sample. The author is deeply indebted to Prof. K. R. Rao for valuable guidance.

TABLE I

$\nu$	Int.	Species	$\nu$	Int.	Species
694	mw	$a''$	*1235	s	$a'$
*750	vvs	$a''$	1263	s	$a'$
790	m	$a''$	1287	ms	$a'$
*820	vs	$a'$	*1448	s	$a'$
*849	ms	$a''$	*1480	vs	$a'$
*939	s	$a''$	*1580	ms	$a'$
*1026	vs	$a'$	1592	s	$a'$
1050	vs	$a'$	3012	m	$a'$
*1117	s	$a'$	3054	ms	$a'$
*1158	ms	$a'$	3158	w	$a'$

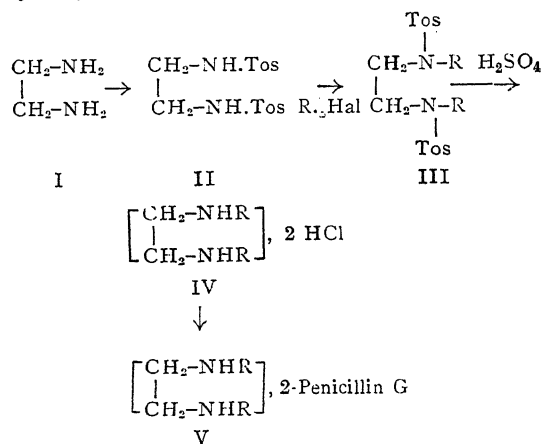
S. L. N. G. KRISHNAMACHARI.

Physics Department,  
Andhra University,  
Waltair, October 5, 1956.

1. Krishnamachari, S. L. N. G., *Ind. Jour. Phys.*, 1956, **30**, 487.
2. —, *Curr. Sci.*, 1956, **25**, 185.
3. Nielsen, J. R. and others, *Jour. Chem. Phys.*, 1956, **24**, 433.

### N:N'-DIALKYLETHYLENE DIAMINE SALTS OF PENICILLIN G

A SYSTEMATIC work has been undertaken to discover repository salts of penicillin which could give blood concentrations of the order of about 0.5 units per ml. for about a week after single injection.<sup>1</sup> In the course of this work a series of N:N'-dialkylethylene diamines (IV) and their dipenicillin salts (V) have been prepared as follows:



No.	R	N-N'-Di- toluene sulphonyl derivative M.P. (III)	N-N'-Dialkyl E.D. Di- hydrochloride M.P. (IV)	Dipenicillin G Salt M.P. (V)
1	Methyl	163-64°	232-34°	132°
2	Ethyl	168	260	104-06
3	N-propyl	120-21	295	92
4	N-butyl	119	295-300	111-12
5	N-amyl	116-17	305-10	102-04
6	Iso-amyl	119-21	293	108
7	N-hexyl	115-16	284-86	89
8	N-heptyl	112	292-93	98
9	N-octyl	82-83	275-78	93
10	N-lauryl	65-66	252-55	76-78

The condensation of ethylene diamine (I) with the alkyl halides gave a mixture of various substituted products. So the diamines (IV) were prepared *via* the toluene sulphonyl derivative (II)<sup>2</sup> which was alkylated with alkyl halide (R hal.) in presence of potassium hydroxide (10%) in ethylene glycol-alcohol mixture at 140° C., the condensed product (III) hydrolysed with sulphuric acid (conc.) and the amines (IV) isolated as the hydrochloride.<sup>3</sup> In the case of compounds

Nos. 4 to 7, the penicillin salts were prepared by treating the aqueous solution of hydrochloride with aqueous solution of potassium penicillin G and in the case of compounds Nos. 1 to 3 and 8 to 10 by treating the penicillin acid in dry ether with the amine in the same solvent. The yields in all the above steps are quantitative.

The study of their properties like solubility, stability, blood levels and toxicity, etc., is under progress and the details will be published in due course.

Our thanks are due to Dr. K. Ganapathi and Dr. R. Kaushal for the keen interest in the work.

Antibiotics Res. Centre, G. N. VYAS.  
Hindustan Antibiotics S. G. DHOPATE.  
(Private), Ltd.,  
Pimpri, Bombay State,  
October 11, 1956.

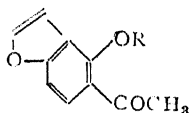
1. Vyas, G. N. and Dhopate, S. G., *Symposium on Antibiotics*, March 1956 (Council of Scientific and Industrial Research, under publication).
2. Amundsen, L. H. and Longley, R. I., *J. Amer. Chem. Soc.*, 1940, **62**, 2812.
3. Boon, W. R., *J. Chem. Soc.*, 1947, 311.

### SOME REACTIONS OF PONGAMOL

HYDROLYSIS of pongamol with absolute alcoholic potash has yielded 5-acetyl-4-hydroxy-benzofuran, m.p. 86° C. (purification by vacuum sublimation) besides 5-acetyl-4-methoxy-benzofuran already isolated<sup>1</sup> by Narayanaswamy *et al.*

Demethylation of 5-acetyl-4-methoxy-benzofuran (I), using hydriodic acid in acetic anhydride solution gave only poor yields of 5-acetyl-4-hydroxy-benzofuran (II), identical with the sample isolated during the alcoholic potash fision. (Found: C, 68.17; H, 4.56; C<sub>10</sub>H<sub>8</sub>O<sub>3</sub> requires C, 68.16 and H, 4.54%.)

The structure of 5-acetyl-4-hydroxy-benzofuran (II) has been established by an independent synthesis. O-acetyl karanjic acid<sup>2</sup> was first converted into the acid chloride using thionyl chloride and then condensed with excess diazomethane to give the diazoketone which was subsequently reduced using hydriodic acid in chloroform solution as described earlier,<sup>3</sup> followed by hydrolysis to give 5-acetyl-4-hydroxy-benzofuran (II) in good yield.



(I, R = CH<sub>3</sub>)

(II, R = H)

5-Acetyl-4-methoxy-benzofuran was similarly obtained starting from O-methyl-karanjic acid.

Dept. of Chemistry, CH. BHEEMASANKARA RAO.  
Andhra University, V. VENKATESWARLU.  
Waltair, July 14, 1956.

1. Narayanaswamy, S., Rangaswamy, S. and Seshadri, T. R., *J.C.S.*, 1954, 1871.
2. Seshadri, T. R. and Venkateswarlu, V., *Proc. Ind. Acad. Sci.*, 1941, **13A**, 404.
3. Venkateswarlu, V., *Curr. Sci.*, 1955, **25**, 155.

### RAUVOLFIA ALKALOIDS IN AVIAN MALARIA (*P. GALLINACEUM*)

BESIDES their well established therapeutic uses in hyperpiesia and psychiatric conditions, the Rauvolfia alkaloids are considered to be of value by practitioners of indigenous medicine, in clinical disorders like diarrhoea, dysenteries and fevers associated with rigor. A partial explanation for their empirical use lies in the antibacterial activity exhibited by the crude total alkaloids (C.T.A.) on *Micrococcus pyogenes* and *Shigella sonne*. Since many of the fevers associated with rigors are malarial in origin, the effect of these alkaloids on experimental malaria has been investigated.

The effects of crude total alkaloids obtained by methods previously described<sup>1</sup> and of reserpine were both studied.

*P. gallinaceum* infections in chicken have been reported to be sensitive to all drugs so far discovered to be active in human malaria<sup>2</sup> and hence the screening of these alkaloids has been carried out on this species.

The evaluation, as carried out by standard technique<sup>3</sup> has shown that the oral administration of crude total alkaloids and reserpine in doses of 200 mg./100 g. and 20 mg./100 g. body weight respectively, did not exhibit any suppressive activity or lessening of the severity of the infection, thus indicating the clinical inefficacy of these alkaloids in avian malaria.

Pharmacology Lab., R. RAMA RAO.  
Indian Institute of Science, M. SIRSI.  
Bangalore-3, August 10, 1956.

1. Shaw, C. N. and Sirsi, M., *J. Mys. Med. Asso.*, 1955, **20** (1), 15.
2. Burn, J. H., Finney, D. J. and Goodwin, L. G., *Biological Standardisation*, 1950, Oxford Medical Publications, p. 412.
3. Rama Rao, R., Viswanathan, K. V., Ramaswamy, A. S. and Sirsi, M., *Curr. Sci.*, 1953, **22**, 305.

# HALF-WAVE POTENTIALS AND ATOMIC CHARACTERISTICS

THERE have been attempts to correlate polarographic behaviour of inorganic depolarisers with the electronic structure.<sup>1</sup> In this connection, the following relationship which reproduces faithfully half-wave potentials of metals will be of interest. The half-wave potential for most metal ions in cathodic reduction to the metal in 0.1N KCl is given by the empirical equation

$$E^E = -2.37 + 8.828 \times 10^{-26} \times Z/XR^3$$

where E is volts vs. S.C.E., Z stands for the atomic number and R is the single bond covalent radius of Pauling. X is a factor which varies from one periodic subgroup to another and assumes for the different subgroups, the values shown in Table I.

TABLE I

Elements	Periodic group	Value of X
Li to Cs	I A	1.0
Zn to Hg	II B	
Al to Tl	III B	
Ge to Pb	IV B	
Bi	V B	1.4
Be to Ba	II A	
Fe to Ni	VIII	
Y to La	III A	
Ti to Th	IV A	2.0
V to Ta	V A	
Cr to W	VI A	
Mn to Re	VII A	
Cu to Ag	I B	0.7
H	..	
Rare-Earths excluding La		4.0
Uranium Special case		5.5

The half-wave potential values recorded in literature do not all refer to standard conditions. Potentials given with respect to the N.C.E. are easily converted to the S.C.E. scale. In some cases measurements were made and recorded in various electrolytes of differing concentrations. The effect of these on the potential values is not very significant.

A comparison of the observed and calculated values for 49 elements including hydrogen and the rare-earths showed an agreement within  $\pm 0.1$  V. Sc however shows a wide deviation amounting to 0.5 V nearly (calculated—2.16 and observed—1.69).

A few typical cases are shown in Table II. The values marked with an asterisk have been taken from the literature.<sup>2</sup> The rest were determined in this laboratory.

TABLE II

Element	$E^{\frac{1}{2}}$ volts vs. S.C.E.	
	Cal.	Obs.
Mn <sup>2+</sup> - Mn°	-1.52	-1.51*
Al <sup>3+</sup> - Al°	-1.78	-1.75*
In <sup>+</sup> - In°	-1.08	-1.10
Pb <sup>2+</sup> - Pb°	-0.38	-0.44*
Ni <sup>2+</sup> - Ni°	-1.14	-1.10*
K <sup>+</sup> - K°	-2.17	-2.14*
Ca <sup>2+</sup> - Ca°	-2.13	-2.22*
Sn <sup>2+</sup> - Sn°	-0.76	-0.83*
U <sup>6+</sup> - U°	-1.86	-1.90
(La to Lu) <sup>3+</sup> - (La to Lu)°	-1.95 to	-1.94 to
	-2.15	-2.14

\* Ref. 2.

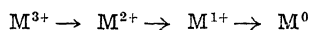
D. V. N. SARMA.

Andhra University, BH. S. V. RAGHAVA RAO.  
Waltair, August 4, 1956.

1. Vlcek, A. A., *Collection Czech. Chem. Comm.*, 1955, p 894.
2. Meites, L., *Polarographic Techniques*, 1955 (Interscience Pub.), Appendix B.

## RARE-EARTHS : POLAROGRAPHIC BEHAVIOUR AND ELECTRONIC CONFIGURATIONS

In a recent communication from this laboratory<sup>1</sup> it has been shown that the reduction of some trivalent rare-earth ions at the dropping mercury electrode in LiCl as supporter occurs in two stages, first to the divalent state and then to the metal. It appears that this reduction in two stages is a characteristic of the rare-earth elements. In some cases, i.e., in elements beyond holmium, by suitably varying the conditions of reduction, three distinct waves have been observed corresponding to the three stage reduction.



The first reduction, i.e.,  $M^{3+} \rightarrow M^{2+}$  occurs between -1.79 to -1.91 vs S.C.E. in all elements Y — Lu except Eu and Yb (Pm could not be investigated). In the latter two cases these potentials lie at -0.76 and -1.4 V respectively. This difference in behaviour is of significance in view of the pronounced stability of their divalent state. However, samarium which is also known to be equally stable in its divalent state, reduces only at a higher negative potential and falls in line with other rare-earths. Thus the chemical behaviour does not account for the observed anomaly.

A likely origin may be in the electronic structures of these two elements. The trivalent

rare-earth ions represent the completed xenon core and 0-14 electrons in 4f levels. The divalent state or the  $M^{2+}$  ion is reached when an electron is added to this core. Where this addition takes place, is of significance in polarographic studies. Accepted structures<sup>2</sup> for the metal atoms of the rare-earths associate one 5d and two 6s electrons with the elements La, Gd and Lu; in all other cases the 5d orbit is vacant and the extra electrons load the 4f orbit. It follows that in La, Gd and Lu, the  $M^{2+}$  ion is formed by the addition of an electron in the 5d level; while in others this electron should enter the 4f level alone. If it were so, the first reduction potentials of the rare-earth ions should fall into two groups—La, Gd and Lu along with Sc and Y falling into one group and the rest into the second. Experimental values point differently; the reduction of  $Ce^{4+} \rightarrow Ce^{3+}$  at 0.0 v and  $Ce^{3+} \rightarrow Ce^{2+}$  at -1.91 V is also of particular interest. On the other hand, when it is assumed that the 5d electron is present in all the elements excepting Eu and Yb in which the d electron passes into the 4f level to assume the more stable configuration of 7 and 14 respectively, the observed anomalies in the polarographic reduction potentials stand readily explained.

Andhra University, D. V. N. SARMA.  
Waltair, BH. S. V. RAGHAVA RAO.  
August 3, 1956.

1. Purushottam, A. and Raghava Rao, Bh. S. V., *Anal. Chim. Acta*, 1955, **12**, 589.
2. Meggars, W. F., *Science*, 1947, **105**, 514.

### ISOLATION OF THREE CRYSTALLINE SUBSTANCES FROM THE SEEDS OF CASSIA TORA LINN.

THE seeds of *Cassia tora* Linn. (Fam. Leguminosæ) are reputed to be a valuable remedy in skin diseases. From them Jois and Manjunath<sup>1</sup> obtained an oil and a small quantity of colouring matter. We have now succeeded in isolating three crystalline substances all of which seem to belong to the group of xanthenes. They are provisionally designated as Tora substances A, B and C corresponding to the sequence in which they were isolated.

**Tora substance A:** orange red rods and needles, m.p. 243-45°; sparingly soluble in sodium hydroxide but soluble in conc. ammonium hydroxide giving yellow solution; with conc. sulphuric acid greenish yellow solution,

the rim slowly turning orange. Colour with alcoholic ferric chloride, greenish brown. Probable formula  $C_{15}H_{12}O_5$ , containing one methoxyl group in the molecule. Diacetate,  $C_{19}H_{16}O_7$ , m.p. 227-29°; dimethyl ether,  $C_{17}H_{16}O_5$ , m.p. 184-85°. Tora substance A seems to be a monomethyl-monomethoxy-dihydroxyxanthone.

**Tora substance B:** yellow needles, m.p. 286-88° (decomp. at 292-94°); yellow solution in sodium hydroxide and sodium carbonate; light pink solution with conc. sulphuric acid and green brown colour with alcoholic ferric chloride. Probable formula  $C_{14}H_{10}O_5$  without any methoxyl. Diacetate,  $C_{18}H_{14}O_7$ , m.p. 206-09°; triacetate,  $C_{20}H_{16}O_8$ , m.p. 216-18°; dimethyl ether,  $C_{16}H_{14}O_5$ , m.p. 207-09°; trimethyl ether,  $C_{17}H_{16}O_5$ , m.p. 186-89°. Tora substance B corresponds to a monomethyl-trihydroxyxanthone and is probably identical with norrubrofusarin, the demethylation product of rubrofusarin which was first isolated from the fungus *Fusarium culmorum* by Ashley, Hobbs and Raistrick.<sup>2</sup>

**Tora substance C:** red shining needles, m.p. 208-09°, sparingly soluble in all organic solvents and in sodium hydroxide; with conc. ammonium hydroxide a deep yellow solution slowly turning to orange; with conc. sulphuric acid a greenish yellow solution, the rim slowly turning orange; with alcoholic ferric chloride a greenish brown colour. Probable formula  $C_{15}H_{12}O_5$  with one methoxyl group. Diacetate,  $C_{19}H_{16}O_7$ , m.p. 267-69°; dimethyl ether,  $C_{17}H_{16}O_5$ , m.p. 183-85°; monomethyl ether,  $C_{16}H_{14}O_5$ , m.p. 207-09°. The dimethyl ether did not depress the m.p. of the trimethyl ether of Tora substance B and the monomethyl ether did not depress the m.p. of the dimethyl ether of Tora substance B. The product of demethylation of Tora substance C did not depress the m.p. of Tora substance B. Tora substance C appears to be a monomethyl-monomethoxy-dihydroxy-xanthone and is probably identical with rubrofusarin.<sup>2</sup> Full details will be published elsewhere.

We thank Prof. C. S. Shah, L. M. College of Pharmacy, Ahmedabad, for the supply of authentic crude drug.

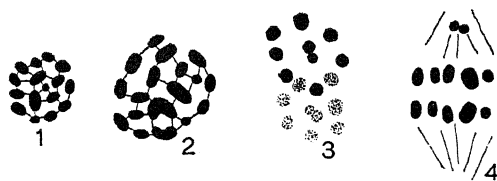
Dept. of Pharmacy, C. S. NARAYANA.  
Andhra University, S. RANGASWAMI.  
Waltair, May 17, 1956.

1. Jois and Manjunath, *J. Ind. Chem. Soc.*, 1930, **7**, 521.
2. Ashley, Hobbs and Raistrick, *Biochem. J.*, 1937, **31**, 385.

# SEX MECHANISM IN *DYSDERCUS* (PYRRHOCORIDAE—HETEROPTERA)

WHILE describing a new type of sex mechanism in *Dysdercus koenigii*, Ray-Chaudhuri and Manna<sup>1</sup> state that the sex chromosomes, X and Y, though split with typical heteropteran orientation at metaphase I, segregate as such during both the meiotic divisions. Consequently such a 'double reduction' results, on an average, in the production of three types of spermatids: 50% without any sex element, 25% with the split X and the rest with the split Y. Recently, however, Battaglia<sup>2</sup> has observed that the male sex mechanism in this species is  $X_1X_2O$  and not XY. He further states that the two sex elements divide equationally during anaphase I, but the close and non-homologous association of the sex univalents at an early period of anaphase I, just as in *Dysdercus mendesi*,<sup>3,4</sup> has probably led Ray-Chaudhuri and Manna to regard this mechanism as a new type.

Recently a study of the male and female chromosome complements during mitosis and meiosis in another congeneric species—*Dysdercus cingulatus* has been completed in this laboratory. This species differs from *Dysdercus koenigii*<sup>1</sup> and *Dysdercus* sp.,<sup>5</sup> in having a heteromorphic pair of the sex chromosomes which retain their individuality from the diakinesis onwards, thus allowing their exact analysis most accurately. The spermatogonial metaphase (Fig. 1) reveals 16 chromosomes which can be



FIGS. 1-4. 1. Spermatogonial metaphase (polar view); 2. Oögonial metaphase (polar view); 3. Anaphase I (sub-polar view); 4. Anaphase II (side view), only five autosomes shown.  $\times 1,500$ .

classified as one pair of large, a single small and thirteen medium-sized elements. That the small element is one of the sex chromosomes and the second is indistinguishable from amongst the medium-sized elements, is also evident by the size relation of the autosomes and the sex chromosomes in the corresponding oögonial plate (Fig. 2) which shows 18 elements in its polar view. Similarly the size relation of the sex chromosomes, which are undoubtedly  $X_1$  and  $X_2$ , at the anaphases of both the meiotic divisions (Figs. 3 and 4) in the male clearly reveals their typical heteropteran behaviour,

thus, confirming the conclusions already arrived at by Battaglia,<sup>2</sup> Mendes<sup>3</sup> and Piza<sup>4</sup> that the sex mechanism in the genus *Dysdercus* is  $X_1X_2O$  and  $X_1X_1X_2X_2$  in the male and female respectively.

A detailed account of these findings on *Dysdercus cingulatus* will be published elsewhere.

Zoological Laboratory, G. P. SHARMA,  
Panjab University,  
Hoshiarpur, August 25, 1956.

1. Ray-Chaudhuri, S. P. and Manna, G. K., *J. Genetics*, 1952, **51**, 191.
2. Battaglia, E., *Caryologia*, 1956, **8**, 205.
- \*3. Mendes-Luiz, O. T., *Bragantia*, 1947, **7**, 243.
- \*4. Piza, S. de Toledo, *Ibid.*, 1947, **7**, 269.
5. Manna, G. K., *Proc. Zool. Soc.*, Bengal, 1951, **4**, 1.

\* Not read in original.

# MACRONUCLEAR REORGANISATION IN *DIOPHRYS APPENDICULATA* (CILIATA HYPOTRICHA)

PRIOR to fission, in *Euplotes patella*,<sup>1</sup> *Aspidisca lynceus*, *Diophrys appendiculata*, *Stylonychia pustulata*,<sup>2</sup> and in *Urostyla grandis*,<sup>3</sup> a peculiar non-staining space, the "reorganisation band" appears in the macronucleus. The reorganisation band traverses the entire length of the macronucleus, leaving the chromatin reticulum in a greatly altered condition.

The process of migration of the reorganisation bands is different in the various species of hypotrichs. In *Euplotes patella*, a pair of bands, one at each tip of the macronucleus, appear and migrate through the substance of the macronucleus, finally disappearing in the middle. In *Aspidisca lynceus*, the band appears in the centre of the "C"-shaped macronucleus, separating a small mass of chromatin. As this grows larger, the band divides into two and move to the opposite sides finally disappearing at the tips of the macronucleus. In other hypotrichs where there is more than one macronucleus, a single reorganisation band appears in each. The passage of the bands has been ascribed to a process of reorganisation.

However, Summers observed in the dumb-bell-shaped macronucleus of the daughter individual of *Stylonychia pustulata* a pair of reorganisation bands. He believes that this may be due to the high fission rate of the culture, when the reorganisation bands of the next fission appear precociously.

It is a matter of considerable interest that in one of the numerous specimens of *Diophrys appendiculata* (Fig. 1) examined a pair of well

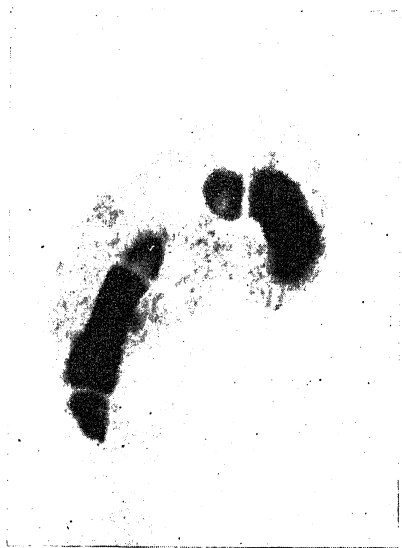


FIG. 1

Photomicrograph: *Diophris appendiculata* macronucleus showing the double bands. (Feulgen's stain.)

defined reorganisation bands in one of the macronuclei was observed. The presence of two reorganisation bands instead of one recalls the type of reorganisation in *Aspidisca*. The chromatin bounded by the two bands in the present case was more densely stained with Feulgen's stain, while the terminal tips were lightly stained, a condition which is similar to that in *Aspidisca* at a later stage of reorganisation. Titler has also observed the double bands in some bits of the macronuclei in *Urostyla grandis*, but the author has not offered any explanation for the presence of the double bands. Further work on the reorganisation of macronucleus in different hypotrichs is in progress.

Dept. of Zoology, P. N. GANAPATI.  
Andhra University, M. V. NARASIMHA RAO.  
Waltair, September 1, 1956.

1. Turner, J. P., *Univ. Calif. Pub. Zool.*, 1930, **33**, 193.
2. Summers, F. M., *Arch. F. Protok.*, 1935, **85**, 173.
3. Titler, I., *Cellula*, 1936, **44**, 189.

#### A NEW SHIPWORM FROM TONDI, SOUTH INDIA

WHILE making a survey of *Teredinidae* in South Indian waters, 18 species of shipworms belonging to the genera *Teredo* and *Bankia* were collected, identified and described.<sup>1-3</sup> Of these, 12 were found to be new to science. Roonwal<sup>4</sup> recorded the occurrence of the genus *Bactronophorus* from the Sundarbans. The present note deals with one more new shipworm *Teredo* (*Psiloteredo*) *tondiensis* of which four entire

specimens and several shells and pallets were collected from the wooden piles (*Borassus flabellifer*) used for the turtle cages in the port of Tondi on the East Coast (Lat. 9° 44' N.; Long. 79° 2' E.).

**Measurements.**—One specimen 6.2 cm. long has been selected as the type for description. Shell length—5.1 mm.; Shell height—5.7 mm.; Diameter of shell—6 mm.; Pallet length—5.6 mm.; Pallet stalk alone—1.3 mm.; Diameter of blade—2.1 mm.

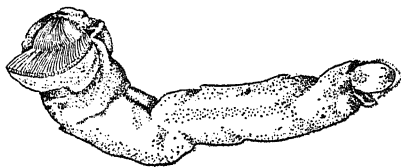


FIG. 1. Entire Animal.

**Characters.**—Shell globular and white. Its extreme anterior portion with a sinus and reflected callus which extends over the anterior external margin of the anterior lobe. From the edge of the sinus about 32 denticulate ridges bent downward and then evenly curve backward towards the anterior median area. They

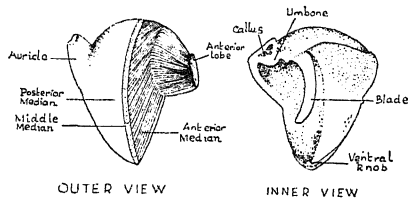


FIG. 2. Shell.

are separated at their posterior termination by spaces slightly wider than the dental ridges. These ridges are finely serrated at their free margin. The anterior lobe is a comparatively broad area which is more than twice the anterior median and equivalent to posterior median and auricle combined. The anterior median portion is a narrow region crossed by about 36 denticulated ridges provided with rows of finely denticulated tubercles and separated by lines of growth. These ridges join those of the anterior area at almost a right angle. The middle median is concave and crossed by coarse low U-shaped non-denticulated extensions of the ridges of the anterior area. The posterior median is slightly wider than either the middle median or the auricle and its surface is smooth. The auricle is only moderately prominent, almost as broad as the anterior median. It is not sharply differentiated from the posterior median portion. Interior pearly white. The auricle joins the posterior median without any differentiation.

The auricle does not in any way project over the posterior median as a shelf. The blade is broad, straight and approximately half the length of the shell. The umbonal knob is strong.

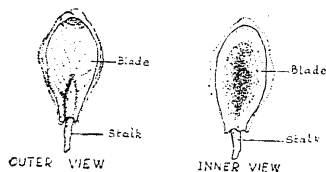


FIG. 3. Pallet

The pallet is spoon-shaped with a short, straight, flexible stalk, which is only slightly more than a fourth of the length of the entire pallet. The blade is roughly oval, the extreme distal portion on the outer surface is marked by a few concentric lines. The inner side is smooth and concave from side to side. The whole pallet blade is covered over by a thick almost transparent periostracum. The inhalent siphon is broader than the exhalent and is fringed at the entrance. In preserved specimens, the siphons are in a state of contraction. Both inhalent and exhalent are conjoint until near the extremities and are almost of equal lengths. A well-developed collar is present at the base of the siphons.

Of the three genera *Teredo*, *Bankia* and *Bac-tronophorus* which constitute the family Tere-dinidæ, the present form belongs to the genus *Teredo* Linnaeus since the pallet is spoon-shaped. This genus *Teredo* established by Linnaeus in 1758 includes a dozen subgenera. The forms before us come under the subgenus *Psiloteredo*, by virtue of the following features: 'The auricle fuses with the posterior median portion on the inside in such a manner that no shelf projects. The pallets are spoon-shaped with the outer distal portion slightly excavated.' This subgenus established in 1922, on the basis of the form *Teredo dilatata* Stimpson, by Bartsch<sup>5</sup> now includes about seven species.<sup>6,7</sup> A comparative study of the description of these suggests that the present form does not belong to any one of them. However, it resembles *Teredo* (*Psiloteredo*) *jamaicensis* Bartsch and *Teredo* (*Psiloteredo*) *sigerfoosi* Bartsch in the general features and relative proportions of the shells and pallets but differ from the first in having a narrow anterior median portion and in having only 32 dental ridges for the anterior lobe. Further the forms before us have a wider posterior median than the anterior median. Again the pallet is described as irregular in shape with a twisted and curved stalk very unlike the present form. *T* (*P*) *sigerfoosi* differ from

the present form not only in the number of ridges on the anterior lobe but also in having a broadly ovate, solid and smooth pallet, whose stalk is irregular and twisted. Hence the present form is described as a new species, *Teredo* (*Psiloteredo*) *tondiensis* and can be defined as follows:

*Teredo* with a distinctly spoon-shaped pallet, with a roughly ovate blade covered by a translucent periostracum and marked by a few concentric lines on the distal aspect of the outer surface, with a flexible stalk which is only slightly more than a fourth of the entire pallet length and with a shell, whose length is less than its height, with a moderately large auricle and an anterior lobe bearing about 32 dental ridges when the shell length is 5.1 mm. and shell height 5.7 mm.

The type will be deposited in the Zoological Survey of India, Calcutta, and the paratypes will be in the Zoology Museum of Alagappa College, Karaikudi.

N. BALAKRISHNAN NAIR.

Dept. of Zoology, O. N. GURUMANI.  
Alagappa College P.O.,  
August 10, 1956.

1. Balakrishnan, Nair, N., *Rec. Indian Mus.*, 1954, **52**, 387.
2. —, *Ibid.* (in press).
3. —, *J. Madras Univ.*, 1955, **25B** (1), 109.
4. Roonwal, M. L., *Proc. Zool. Soc., Bengal*, 1954, **7** (2), 91.
5. Bartsch, P., *Bull. U.S. Nat. Mus.*, 1922, **122**, 1.
6. —, *Proc. Biol. Soc. Wash.*, 1923, **36**, 95.
7. —, *Bull. U.S. Nat. Mus.*, 1927, **100** (2), 533.

#### OCCURRENCE OF INTRA-NUCLEAR NEUROSECRETORY MATTER IN THE TADPOLES OF *RANA* *HEXADACTYLA* LESSON

AMPHIBIAN neurosecretory cells and their relationship to the hypophyseal system have been investigated by various authors.<sup>1</sup> Studies on species of *Bufo* and *Rana pipiens* have demonstrated that cytoplasmic components, stainable blue by Gomori's chrome alum-haematoxylin, are transported along the axons of the neurosecretory cells to the neurohypophysis. In addition Hild<sup>2</sup> and Imai<sup>3</sup> have also drawn attention to the liberation of stainable secretory colloids into the extracellular space to be ultimately released into the diencephalic ventricle. In examining the neurosecretory system of the common frog *Rana hexadactyla* Lesson, it was observed that in the tadpole,

stainable granules and tiny droplets are produced inside the nucleus of the neurosecretory cells of the pre-optic region.

In tadpoles aged about 45 days the pre-optic nucleus is well defined and each neurosecretory cell of this region measures  $7\mu$  to  $8.4\mu$  in length, with a nucleus of about  $5.6\mu$  in diameter. Granular colloids fill the cytoplasm of these cells and axons measuring up to  $14\mu$  in length have been followed up from these cells. In the nuclei of these cells granular bodies stainable bright blue in Gomori's chrome alum-haematoxylin, measuring about  $0.7\mu$  in diameter have been observed. Often similar granules are seen aggregated on the outer surface of the nuclear membrane. In some instances intranuclear vacuoles have also been observed with neurosecretory colloids collected along their walls and occasionally within them (Fig. 1).

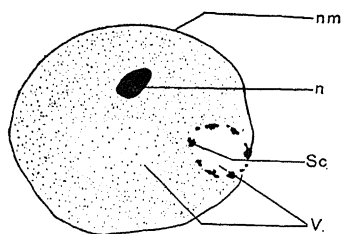


FIG. 1. Diagram showing the nucleus of a neurosecretory cell of the pre-optic region of the tadpole of *Rana hexadactyla*. n—nucleolus; nm—nuclear membrane; Sc—secretory matter; V—vacuoles.

The stainable intra-nuclear granules are not, however, confined to the larval neurosecretory cells. In adults also scattered granules of various dimensions are seen occasionally within the nuclei of the neurosecretory cells. But the bulk of the neurosecretory matter is found outside the nucleus, in the cytoplasm of the cells. These cells are bigger measuring about  $14\mu$  to  $25\mu$  in length with a nucleus of about  $8.4\mu$  diameter and axons over  $83\mu$  in length are of general occurrence.

Though the intra-nuclear production of neurosecretory matter has not been observed in Amphibians so far, it has been shown to be present in the pre-optic nucleus of cat fishes<sup>4</sup> and the eel<sup>5</sup> and in crustacean neurosecretory cells.<sup>6</sup> It is interesting to note that the occurrence of intra-nuclear neurosecretory matter is more marked in the tadpole stages than in the adults of *Rana hexadactyla*.

I wish to thank Dr. K. Bhaskaran Nair for

facilities and guidance, and Dr. K. K. Nayar for constant help, encouragement and guidance.

K. VIJAYAPRASANTHAN PILLAY.

Dept. of Zoology,  
University College,  
Trivandrum, June 5, 1956.

1. Scharrer, E. and B., *Hand. Mikr. Anat. Mencher*, 1954, **6**, 953.
2. Hild, W., *Z. Anat. Entw-Gesch.*, 1951, **115**, 459.
3. Imai, K., *Endocrinol. Japonica*, 1955, **2**, 41.
4. Scharrer, E. and B., *Phys. Rev.*, 1945, **25**, 171.
5. Enami, M., *Endocrinol. Japonica*, 1955, **2**, 33.
6. —, *Biol. Bull.*, 1951, **101**, 241.

#### SOME OBSERVATIONS ON THE CYTOLOGY AND ANATOMY OF *HYPODEMATIUM CRENATUM* (FORSK.) KUHN.

GENUS *Hypodematiium* Kunze is one of the little known genera of the Leptosporangiate Ferns. There is a variety of suggestions regarding its phyletic position. Ching<sup>2</sup> considers it a genus of Thelypteroid affinity. Copeland<sup>3</sup> places it near *Woodsia* as was originally suggested by Kunze, while Holttum<sup>4</sup> describes it under the sub-family Tectarioideae of the family Dennstaedtiaceae.

Ching<sup>1</sup> lists three species of the genus, namely *H. crenatum* (Forsk.) Kuhn., *H. fordii* (Baker) Ching and *H. cystopteroides* Ching, the latter two species being known only from China. The type species *H. onustum* Kunze is regarded as a synonym of *H. crenatum* (Copeland<sup>3</sup>). *H. crenatum* has a wide range of distribution from Arabia to Southern Asia and Japan. In Himalayas it ranges from Garhwal to Bhotan (2,000-7,000'), Khasya (2,000-4,000'), South India and Western Ghats. At Mussoorie the species grows in abundance between Kempty Falls and Jamna Bridge as reported by Mehra.<sup>5</sup>

The present note aims to record the chromosome number of the species *H. crenatum* and chief points in its stelar anatomy. The basic chromosome number for the genus is not known so far.

The material was collected from Chakrata road on the way to Kempty Falls. Fertile leaflets were fixed in 1:3 acetic alcohol prior to squashing in aceto-carmin. Stelar anatomy was studied by extracting the stelar skeletons in their entirety.

The species grows on ledges and in crevices of huge cliffs of limestone along the roadside under highly xerophytic conditions. The rhizome is short, creeping and dorsiventral. The fronds are borne crowded together on the dorsal side. The insertions tend to form diagonal as well as longitudinal rows without any



regularity. A few buds may be present mostly laterally to the petioles but these remain dormant as long as the parent rhizome continues its growth. From the ventral side long, wiry adventitious roots are struck into the cracks. The rhizome as well as the basal portion of the stipe are densely clothed with golden brown, linear and lanceolate scales. The scales according to Ching<sup>1</sup> are naked and without any marginal projections but in our material occasional marginal peg-like projections or even sometimes long, multicellular filaments resembling somewhat those of *Tectaria* are noticeable. Stipe is inflated at the base and abruptly becomes slender above. Lamina 3-4 pinnate, deltoid, lowest pinnæ the largest, setose throughout with unicellular needle-like hairs. Sori are borne dorsally on the veins on the under-surface of the frond on prominent receptacles. Indusium is hairy throughout, reniform, usually asymmetrical, attached by a deep sinus.

At 'diakinesis' 41 bivalents are observed without doubt (Fig. 1). The meiosis is per-



FIG. 1.  $n = 41$ ,  $\times 1,140$ .

fectly normal and 64 functional spores are formed. This chromosome number for the species indicates its possible affinity with genera like *Woodsia*, *Dryopteris* and *Ctenitis*, etc.

The rhizome is dorsiventral and its ventral side is traversed by a single broad meristele (Fig. 2A). This meristele remains undissected throughout its length because of the absence of the leaves on this side of the rhizome. The root traces are mostly given off from its central portion. Traces to the buds are associated with the margins of this meristele.

The dorsal stele presents a highly dissected picture because of the insertion of leaf traces (Fig. 2B). There are two or three dorsal meristeles, the number being determined by the rows of leaves present (commonly three rows but at places only two). These dorsal meri-

steles are united with the ventral meristele through small vascular bridges at the regions of the initiation of the leaf gaps. No root traces are ever given off from the dorsal meristeles.

The leaf trace is binary (Fig. 2B). The two

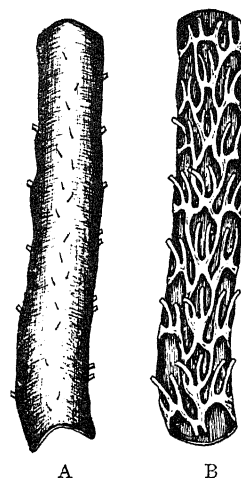


FIG. 2. A and B. Stelar skeleton from a portion of rhizome showing (A) ventral and (B) dorsal views. Diagrammatic, about double the natural size.

vascular strands depart just at the point of the initiation of the gap or a little above from either side of the cauline meristeles enclosing the gap. These strands extend as such into the petiole but in the rachis they ultimately get united to form a single 'V'-shaped meristele.

The trace to the pinna is extra-marginal, being the characteristic of many genera of *Dryopteroid* affinity.

The present study reveals that the genus is interesting because of its synthetic nature. The species has a combination of characters which are shared by a number of other genera like *Woodsia*, *Dryopteris*, *Tectaria*, *Thelypteris* considered both primitive and advanced which have been placed in separate subfamilies by some recent workers. Detailed discussion on the affinities of the genus will be presented later. We are thankful to Mr. B. Khanna for help with the drawings.

Dept. of Botany,  
Panjab University,  
Amritsar, July 18, 1956.

P. N. MEHRA.  
D. S. LOYAL.

1. Ching, R. C., *Fan. Mem. Inst. Biology, Peiping*, 1935, China.
2. —, *Sunyatsenia*, 1940, 5, 206.
3. Copeland, E. B., *Genera Filicum*, 1947, Waltham, Mass. U.S.A.
4. Holttum, R. E., *Flora of Malaya, II. Ferns of Malaya Singapore*, 1954.
5. Mehra, P. N., *Ferns of Mussoorie*, 1939, Panjab Univ. Publ., Lahore.

# OCCURRENCE OF MEGASPORES IN THE COAL FROM THE SOUTH REWA GONDWANA BASIN\*

SAMPLES of coal for microscopic studies were collected by the author<sup>1</sup> in 1951 from a number of coalfields in Vindhya Pradesh. Preliminary findings from the first lot of coal samples included one-winged spores of *Endosporites* and *Florinites*, two-winged spores of the type *Pityosporites*, pieces of wood assignable to the genus *Mesembrioxylon* and coniferous cuticles.<sup>2</sup> The second lot of samples macerated with the usual Schultze solution yielded a few megaspores, besides a great number of spores, wood fragments and cuticles.

The presence of megaspores in the coal from the South Rewa Gondwana Basin is interesting as it affords evidence for the existence of Lycopodiaceous vegetation in the Palaeozoic of India which is otherwise unknown. Except Raniganj and Jharia coals, other Lower Gondwana coals have shown a few megaspores. Record of megaspores from Indian coal is on the whole scanty. Fossil megaspores from India have been reported by Mehta,<sup>3</sup> Sitholey,<sup>4</sup> Sahni,<sup>5</sup> Trivedi<sup>6</sup> and Tripathi.<sup>8</sup> The present author<sup>1</sup> has also reported megaspores from coal from a thin seam exposed in Bandha Nala, south of Ujhni (24° 10' : 82° 25'), Vindhya Pradesh. The number of megaspores released from the Ujhni sample is great. These are being arranged under different types and an attempt is being made to describe these and to discuss their affinities. Apart from these reported megaspores, the author has not come across any other published record of megaspores from India. Due to lack of sufficient data of plant constituents of coal from the different seams in Vindhya Pradesh, it is not yet possible to differentiate and correlate the coals and the coal-seams of the area. Further details of fossil flora of the area may no doubt help in solving this problem.

Regarding the samples from the first seam in Mine 2, Dhanpuri (Burhar), at 23° 11' 15" N : 81° 35' 30" E, it was found that all the megaspores are radially symmetrical with distinct proximal and distal sides. The proximal surface is marked by triradiate sutures which in some of the types extending upto the periphery. The distal side is generally smooth or variously ornamented. The proximal side is not so well ornamented as compared to the distal

one. Most of the megaspores are well preserved and their ornamentation and the triradiate marks are very clear. Some of the megaspores are covered with finger-like appendages which are bifurcated into 2-4 branches at the apex. The megaspores vary greatly in size and some are relatively very large upto more than 2 mm. (This increase in size in some of the cases is certainly due to their flattening under high pressure.) Most of the megaspores range between 440  $\mu$ —1.5 mm.

The megaspore (Fig. 1) is somewhat roundish in shape and measures ca. 896.4  $\mu$   $\times$  846.6  $\mu$

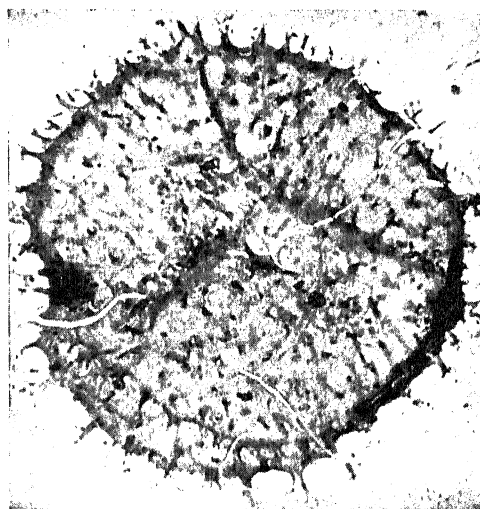


FIG. 1. Megaspore with triradiate mark and spiny surface,  $\times 100$ .

in diameter. The triradiate mark is clear. The arms of trilete are almost extending to the margin. The surface of the megaspore is thickly studded with short and pointed spines mostly bifurcating into 2-4 branches near their ends and these branches are curling outwards on either side. Spines ca. 66.4  $\mu$  long and ca. 12.3  $\mu$ —16.6  $\mu$  broad near the base. The megaspore shows an affinity with the free-sporing lycopsids and may be placed in the genus *Triletes* Reinsch.

The other megaspore (Fig. 2) is roundish in shape with smooth and transparent exine. The surface is with many folds. Maximum diameter ca. 496  $\mu$   $\times$  464.8  $\mu$ . Commissural ridges (triradiate mark) clear, one of the ridges just extending to the periphery and the other two ridges about 1/3 away from the periphery. From its size, shape and surface characters this megaspore can be placed in the genus *Selaginellites*.<sup>4</sup>

\* The work has been carried out with the help of a research grant awarded by the Scientific Research Committee of the U.P. Government.

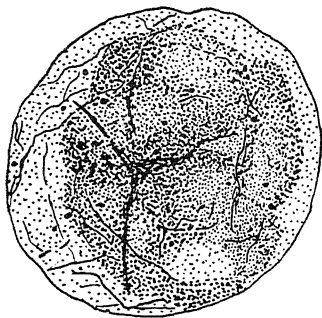


FIG. 2. Megaspore with transparent exine and smooth surface,  $\times 90$ .

A detailed account will be published elsewhere.

The author expresses his indebtedness to Prof. K. R. Mehta for guidance and keen interest evinced in this work, to Dr. G. S. Puri for help and valuable suggestions and Dr. L. B. Singh for facilities and constant encouragement.

Dept. of Biology,  
Shakumbri Das College,  
Saharanpur (U.P.),

S. K. GOSWAMI.

July 3, 1956.

1. Goswami, S. K., *J. Sci. Res. B.H.U.*, 1950-51, 1.
2. —, *Ibid.*, 1951, 52, 2.
3. Mehta, K. R., *J. Ind. Bot. Soc.*, 1943, 23, 174.
4. Miner, E. L., *J. Wash. Acad. Sci.*, 1932, 22, Nos 18, 19.
5. Sahni, B., *J. Ind. Bot. Soc.*, 1947, 25, 241.
6. Sitholey, R. V., *Proc. Nat. Acad. Sci. Ind.*, 1943, 13, 300-27.
7. Schopf, J. M., Wilson, L. R. and Ray Bentall, *Report of Investigation No. 91*, 1944, Illinois State Geol. Surv.
8. Tripathi, B., *Curr. Sci.*, 1952, 21, 308.
9. Trivedi, B. S., *Ibid.*, 1950, 19, 126.

### THREE UNDESCRIBED SPECIES OF XANTHOMONAS

WHILE making a plant disease survey around Poona, the authors came across three bacterial diseases which on morphological and cultural studies proved to be undescribed species of *Xanthomonas*. A preliminary account of the symptomology, morphology and biochemical characters of the disease inciting organisms is presented here.

*Xanthomonas spermacoces* sp. nov. Srinivasan, Thirumalachar and Patel.—A bacterial disease inciting severe spotting on the leaves of *Spermacoce hispida*, Linn. (Rubiaceae) was

observed during August-September, 1955. The pathogen produces a few to several water-soaked, dark-black, circular, crust-like spots on the leaves. These spots sometimes coalesce and produce large, irregularly blotched areas. The organism is so far found to be restricted to *S. hispida* and since no bacterial disease has so far been reported on this host, the pathogen is assigned the status of a new species. The technical description of the pathogen is briefly as follows:

Short rods with rounded ends; single or in chains of two; measuring  $1.2-2.0(1.6) \times 0.5-0.9(0.7) \mu$ ; gram negative; capsulated; non-spore-forming; non-acid fast; motile by a polar flagellum; colonies on potato dextrose agar plates, circular with entire margins, glistening, butyrous, measuring 8-11 mm. in 8 days, Barium yellow (R); good, cloudy, yellow growth in nutrient broth; growth on potato cylinders copious; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised; litmus reduced; ammonia and hydrogen sulphide produced from peptone; nitrates not reduced; indol not produced; M.R. and V.P. tests negative. In a peptone-free medium, acid without gas from dextrose, sucrose, lactose and mannitol; alkali in raffinose and acetic acid; no growth in salicin. Loeffler's blood serum liquefied within 10 days; optimum temperature for growth  $28-30^{\circ}\text{C}$ .; aerobic; thermal death-point  $51^{\circ}\text{C}$ .

Pathogenic on leaves of *Spermacoce hispida*. Collected at Pimpri, near Poona.

*Xanthomonas tribuli* sp. nov. Srinivasan, Thirumalachar and Patel.—The disease appears as minute, water-soaked spots visible on the under-surface of the leaves of *Tribulus terrestris*, Linn. (Zygophyllaceae), which with the advancement of the disease turn darker and appear adaxially as deep brownish-black and rounded areas. Under conditions of heavy infection, the spots coalesce and cause defoliation. Bacterial exudation is evident in the form of fine crusts on the upper surface of the leaves. Since no bacterial pathogen has so far been described on any member of Zygophyllaceae, it is presented here as new to science with technical description as follows:

Slender rods with rounded ends; single or occasionally in chains of two; gram negative; capsulated; non-spore-forming; non-acid fast; motile by a polar flagellum; measuring  $1.6-2.2(1.9) \times 0.7-0.9(0.8) \mu$ ; colonies on potato dextrose agar plates, circular with entire margins, smooth, glistening, butyrous, measuring 7-8 mm. in 8 days, Pinard yellow (R); very heavy growth in nutrient broth with a thick pellicle; growth on potato cylinder copious and flowing;

gelatin liquefied; starch not hydrolysed; casein digested; milk peptonised; litmus reduced; ammonia from peptone but no hydrogen sulphide; indol not produced; nitrates not reduced to nitrites; M.R. and V.P. tests negative. In peptone-free medium, acid without gas from dextrose, maltose, lactose, sucrose and glucose; no growth in salicin and dulcitol; Loeffler's blood serum liquefied. Optimum temperature for growth 28° C.; aerobic; thermal death-point about 53° C.

Pathogenic on leaves of *Tribulus terrestris*. Collected at Pimpri, near Poona.

*Xanthomonas blepharidis* sp. nov. Srinivasan, Patel and Thirumalachar.—The disease symptoms on the leaves of *Blepharis molluginifolia*, Pers. (Acanthaceae) are first visible as minute, circular, water-soaked, greenish to light brown spots on the lower surface, the corresponding areas on the upper surface appearing as minute, black dots. With the advancement of the symptoms, the spots enlarge in size, turning deep brown to dark black, and sometimes angular when coalescing. Bacterial exudate in the form of very fine scales is evident on the lower surface of the leaves. Since this is the first record on a member of Acanthaceae, the pathogen is assigned a new name. Its technical description is as follows:

Short rods with rounded ends; single but rarely in chains of two; measuring 1.5-1.9 (1.7) × 0.6-0.8 (0.7)  $\mu$ ; gram negative; non-spore-forming; non-acid fast; capsulated; motile by a polar flagellum; colonies on potato dextrose agar plates, circular with entire margins, butyrous, glistening, Barium yellow (R); good growth in nutrient broth; copious, yellowish growth on potato cylinders; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised; litmus reduced. In peptone-free medium, acid without gas in dextrose, sucrose, lactose and mannitol; alkali in acetic acid; very poor growth in dulcitol and no growth in salicin; ammonia and hydrogen sulphide produced from peptone; indol not produced; nitrates not reduced; M.R. and V.P. tests negative; Loeffler's blood serum liquefied; optimum temperature for growth 27-30° C.; aerobic; thermal death-point about 52° C.

Pathogenic on leaves of *Blepharis molluginifolia*. Collected near Parvati Hills, Poona.

Fuller details will be published elsewhere.

Plant Path. Lab., M. C. SRINIVASAN.  
Agric. College, M. K. PATEL.  
Poona, September 4, 1956.

## CRYSTALLINE COMPONENTS OF CERTAIN INDIAN PINES

SAMPLES of *P. longifolia* and *P. gerardiana* used in the present work were kindly supplied by the Chief Conservator of Forests, Himachal Pradesh, from North-West Himalayas; and *P. khasya* was collected by Prof. Seshadri from Khasi Hills. The method of extraction and fractionation was the same as has already been described by Mahesh and Seshadri.<sup>1</sup>

The heartwoods of *P. longifolia* and *P. gerardiana* have been subjected to chromatographic study by Linstedt and Misiorny,<sup>2</sup> who detected the presence of pinobanksin, pinocembrin and pinosylvin in *P. longifolia* and pinobanksin, pinostrobin, strobobanksin, pinosylvin pinosylvin monomethyl ether and dihydropinosylvin monomethyl ether in *P. gerardiana*.

In the present study the heartwood of *P. longifolia* revealed the presence of pinobanksin (·02%), pinocembrin (·015%) and a stilbene derivative which was identified as pinosylvin monomethyl ether (·02%). From the heartwood of *P. gerardiana* could be isolated and characterised pinobanksin (·03%), pinostrobin (·005%), pinosylvin monomethyl ether (·05%) and 1-arabinose. The heartwood of *P. khasya* contained pinocembrin (0·12%), pinosylvin monomethyl ether (1·15%) and 1-arabinose.

The stilbene derivatives present in pines are responsible not only for the non-digestibility of pine heartwoods, but also for their high resistance to attack by wood destroying fungi.<sup>3</sup> These compounds were shown to inhibit the normal sulphite pulping by condensation with lignin<sup>4</sup> and were found to be very toxic to bacteria, fungi, insects, fish and mice. All the three pines studied here contain pinosylvin monomethyl ether and *P. khasya* having the largest percentage should be the most durable.

Our thanks are due to the Council of Scientific and Industrial Research for a research grant, and to Prof. T. R. Seshadri for his keen interest in this work.

Dept. of Chemistry, Y. K. AHLUWALIA.  
University of Delhi, ISHWAR DASS.  
Delhi-8 (India), A. C. MEHTA.  
August 28, 1956.

1. Mahesh, V. B. and Seshadri, T. R., *J. Sci. Ind. Res.*, 1954, **13 B**, 835.
2. Lindstedt, G. and Misiorny, A., *Acta Chem. Scand.*, 1952, **6**, 744.
3. Rennerfelt, E., *Ibid.*, 1949, **3**, 1343.
4. Erdtman, H., *Svensk. Papp. Tidn.*, 1939, **42**, 344.

# NEUROSECRETORY PATHWAYS IN *CALOTES VERSICOLOR*

THE hypothalamo-neurohypophyseal tract as a pathway for the passage and discharge of the neurosecretory material produced in the hypothalamus, has been demonstrated in all major groups of vertebrates.<sup>1-3</sup> In certain reptiles the presence of another pathway leading from the cells of the paraventricular nucleus to the commissura pallii posterior and the paraphysis has been observed.<sup>4,5</sup> Yet a third route of exit for the neurosecretory material was described by Stutinsky in the eels.<sup>6</sup> This consisted of the axons of the cells of the preoptic nucleus discharging their contents into the cavity of the third ventricle. This pathway, according to Stutinsky, has not been observed in any other vertebrates.

Brains of garden lizards were fixed in Zenker-formol or Bouin's fluid, embedded in paraffin, sectioned at 6-7 micra thickness and stained by Gomori's chrome-haematoxylin phloxin method. Some sections cut at 15-25 micra thickness were stained by the urea-silver nitrate method as described by Ungewitter.<sup>7</sup>

The axons of the supraoptic and paraventricular nuclei stained deep blue by the chrome-haematoxylin method. Most of these axons passed down the infundibular stalk into the neurohypophysis where they ended in large masses of colloid in the matrix intervening between the ependymal layer and peripheral blood vessel zone. Some of the axons, however, ended in the distal half of the infundibular stalk where the intra-axonal granules coalesced and formed large masses of blue colloid (Fig. 1).



FIG. 1. Sagittal section of the infundibular stalk showing the fibres of the hypothalamo-hypophyseal tract and Gomori positive granules concentrating towards the peripheral blood vessels.

This material uniformly showed a very intimate relationship with the radicals of the por-

tal blood vessels coming in from the anterior margin of the infundibular stalk.

The processes of the neurones of the paraventricular nucleus mainly coursed ventrally and laterally to join the fibres of the supra-optico-hypophyseal tract. However, the neurones belonging to the medial portion of the nucleus were seen to send in well-defined and thick processes towards the cavity of the third ventricle. These cells were scattered in the ependymal lining of the third ventricle, which in this situation consisted of stratified columnar and non-ciliated cells (Fig. 2). These fibres

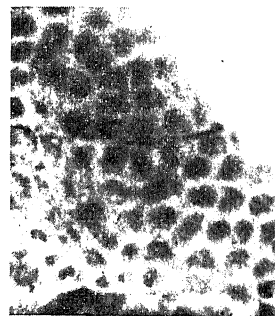


FIG. 2. Sagittal section of the hypothalamus showing a process of the paraventricular cell passing between the ependymal cells of the third ventricle. Towards the top right is the cavity of the third ventricle.

stained deep blue and often showed the typical beaded appearance exhibited by the axons of the neurosecretory cells. In certain other cases the processes stained less intensely, particularly at their terminal points, which gave the impression of their contents being discharged into the ventricular cavity (Fig. 3). The

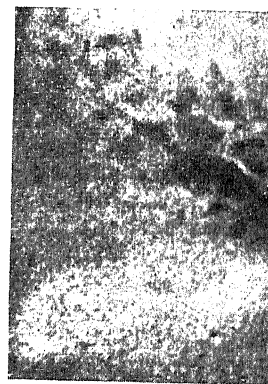


FIG. 3. Sagittal section of the hypothalamus showing a paraventricular cell lying in the ependymal lining. (The above sections were stained by Gomori's chrome-haematoxylin phloxin method. Photomicrographs,  $\times 570$ .)

Gomori positive material has not been observed in the ventricular cavity itself.

In spite of very careful examination, no material resembling the neurosecretory colloid could be seen in the posterior pallial commissure or the paraphysis. Indeed, no Gomori positive cell or material was ever seen dorsal to the level of the sub-thalamus in any one of the specimens studied. This does not agree with the observations of Ananthanarayanan.<sup>5</sup>

Extra-cellular occurrence in the hypothalamus of relatively large globules of Gomori positive material was a very frequent observation. The significance of this is not known.

In *Calotes versicolor* therefore, the avenue for the discharge of the neurosecretory material consists of the hypothalamo-hypophyseal tract (shared with all the vertebrates studied so far) and possibly another exit (shared only with the eels as far as is known now) through the ventricle and the contained cerebro-spinal fluid.

I am greatly indebted to Professor V. Sitarama Rao for his valuable guidance in the investigations reported above.

Dept. of Anatomy, K. R. PANDALAI.  
Andhra Medical College,  
Visakhapatnam-1, May 17, 1956.

1. Bargmann, W. and Scharrer, E., *Am. Scientist*, 1951, **39**, 255.
2. Scharrer, E. and Scharrer, B., *Physiol. Revs.*, 1945, **25**, 171.
3. —, *Proceedings of the Laurentine Hormone Conference*, 1954, 10.
4. Scharrer, E., *Biol. Bull.*, 1951, **101**, 106.
5. Ananthanarayanan, V., *Z. f. Zellforsch.*, 1955, **43**, 8.
6. Stutinsky, F., *Pubbl. Staz. Zool. Napoli*, 1954, Suppl. **24**, 36.
7. Ungewitter, L. H., *Stain Tech.*, 1951, **26**, 73.

#### OCCURRENCE OF HETEROSPORIUM DISEASE OF GARDEN NASTURTIIUM IN INDIA

ON a trip to Mussoorie for the collection of mycological specimens during October 1955, a very severe leaf-spot disease of garden nasturtium (*Tropaeolum majus* L.) caused by *Heterosporium tropaeoli* Bond was observed in a few gardens. The disease is very conspicuous due to the blighted appearance of nasturtium flower beds. This disease has not hitherto been reported from India but has been recorded from

U.S.A., Guatemala, Ceylon, New South Wales, and Tanganyika Territory. In California, where the crop is also grown commercially for seed production, the disease is reported to inflict heavy losses by reducing considerably the yield of nasturtium seed. It is a serious problem in garden plantings wherever the disease is found.

The fungus attacks the above-ground parts of the plant, such as tender stems, leaves and fruit. Leaf-spots appear first as tiny red flecks which enlarge and form round or irregular spots 0.5-2.0 cm. in diameter. Such spots are amphigenous, confluent and tan-coloured with a dark centre. Badly affected leaves become chlorotic and wither. The centre of the old spots dries up and sometimes cracks. Irregular discoloured areas are commonly seen on the infected fruit. The causal fungus has olive brown, septate mycelium which ramifies through the host tissues. Conidiophores grow out through stomata singly or in groups of two or three stalks on both the leaf-surfaces. They are olive brown, simple but sometimes branched, geniculate and are swollen at the tips. They are highly variable in size being 40-120  $\mu$  long and 7-10  $\mu$  broad. The conidia are olive brown with verrucose walls, cylindric, 1-3 septate with a broadened basal cell showing conspicuous scar, and constricted at the septa. They are borne successively singly at the new growing tips of the conidiophores and measure 28-45  $\mu$ .

In India this disease has been observed at Mussoorie which is situated at an altitude about 6,500 ft. Bond<sup>1</sup> observed this disease in Ceylon at 4,000-6,000 ft. elevation, which indicates that the disease is confined to cooler places. As the disease is reported to be seed-borne by Baker and Davies,<sup>2</sup> the possibility of its introduction into India through the infected seed, imported by some nursery men, cannot be ruled out.

Div. of Mycology and  
Plant Pathology,  
Indian Agric. Res. Inst.,  
New Delhi, September 5, 1956.

B. L. CHONA.  
J. N. KAPOOR.

1. Bond, T. E. T., *Ceylon J. Sci.*, 1947, Sect. A, **12**, 171.
2. Baker, F. K. and Davies, L. H., *Phytopathology*, 1950, **40**, 553.

---

## REVIEWS

---

Peaceful Uses of Atomic Energy: Vol. 3: Power Reactors; Vol. 8: Production Technology of Materials Used for Nuclear Energy; Vol. 9: Reactor Technology and Chemical Processing. (Published by the Department of Public Information, United Nations, New York, U.S.A.) Available in India from: Orient Longmans Ltd., Calcutta, Madras and New Delhi. Price \$ 10.00 each.

(i) *Volume 3* is a compilation of all important papers on power reactors submitted at the Geneva Conference on the Peaceful Uses of Atomic Energy held in 1955.

The first three papers deal with the economics of fuel cycles. Most of the discussions centre on the relative merits of thorium - $U^{233}$  and plutonium - $U^{238}$  fuel cycles. Of particular interest is the paper by Weinberg who gives a summary of different fuel cycles, the effects of fission product poisoning and the various reactor types. The discussions indicate fair prospects for the thermal  $U^{233}$ -thorium cycle with breeding gains of 10% to 15% or the fast  $Pu^{239}$ - $U$  cycle where gains of as much as 50% may be obtained if the energy of neutrons is kept above .1 Mev.

The second part is mainly devoted to the working of nuclear power plants. The atomic power station of U.S.S.R., using a water-moderated, water-cooled, 5% enriched uranium fuelled reactor is described in detail. The reactor has an overall power of 30 kw. and produces 5 kw. electrical energy. Experiments on boiling water power reactors conducted in the States using 90% enriched uranium are described in the next paper. This paper describes the various characteristics as well as the economics of such power plants.

The next section contains mainly papers on natural U-graphite reactors. The gas-cooled reactors that are now being built by U.K. and France as well as designs on water-cooled and sodium-cooled reactors are discussed. The advantages of boiling types of reactors especially for small economical plants have been brought out in a number of papers by U.S.S.R. and U.S.A. Though this type of reactors still offers a number of engineering difficulties, it is felt that these difficulties could be surmounted in the near future.

The last section contains descriptions of certain prototype reactors, like the pressurised water reactors and aqueous homogeneous reactors. There is also a review of power reactor experiments conducted at Los Alamos.

This is the first time that such a consolidated report on the engineering designs and difficulties of various types of power reactors has been published. The discussions of the papers included in the volume would be of great help since they contain information usually not found elsewhere. This collection of papers and discussions on power reactors would be of great help to both engineers and physicists in designing future power reactors.

G. S. MANI.

(ii) *Volumes 8 and 9* under review constitute two of the three volumes devoted to the chemical aspects of the peaceful uses of atomic energy.

*Volume 8* is divided into seven sections. Nearly a quarter of the volume is devoted to the treatment of uranium and thorium ores, and the contributions give a clear picture of the principles involved in the concentration of the ore as well as the recovery. These include both solvent extraction and ion exchange processes, metallurgical techniques that have come into prominence by their utilisation in this field on account of the need for extraction even from low grade ores. In this series, an interesting contribution by Marvin shows the possibility of physical beneficiation as a commercial technique. The studies have also shown the limitations of the flotation method.

Seven papers in the next section give a clear picture of the production of metallic uranium and thorium. In the production of raw materials, several problems of analytical chemistry have arisen, and naturally a large number of contributions are devoted to this aspect. The variety of raw materials needed—as many as twenty different elements are involved—have necessitated a large amount of work on micro-techniques, both physical and chemical, and all these find a place, with a clear indication of the limitations of each technique.

One of the important components in the utilisation of atomic energy is heavy water, and the papers presented cover the different methods

of large-scale preparation. These clearly show that from all angles, by far the best method is the one of deuterium exchange with steam. Another equally important material is graphite and we have a glimpse of the different aspects of production of the pure material from coke as well as petroleum coke. In the record of the session we have just an indication that suitably treated natural graphite can also find its use.

The study of atomic energy has brought into prominence two 'rare' metals, zirconium and beryllium. The discovery of hafnium was preceded by a study of zirconium minerals and the production of pure zirconium by the separation from hafnium has had special attention. The last two sections of the volume give a review of the relevant chemistry of zirconium and of beryllium.

Volume 9 deals with the various problems arising from technological studies of nuclear energy utilisation. Prominent among these is the disposal of waste, and this covers a good part of the volume. The discussions clearly show that the major controlling factor determining the extent of the use of atomic energy is the disposal of reactor and fuel processing waste. Other sections are devoted to metallurgy of reactor fuel elements, the system of intermetallic compounds met with, and problems in the handling of liquid metals that find extensive use for heat transfer in fuel systems. Several contributions bring out clearly the corrosion problem in the handling of molten liquid metals. As may be expected, nearly a third of the volume is devoted to the problem of processing fuel elements. The discussions bring out the picture that "the efficiency of any nuclear programme depends not only on efficiency of the nuclear reactor but in the efficiency of processes in all other stages of the fuel cycle". We find also the special features of reactors with liquid and fluidised fuels with an elegant homogeneous aqueous reactor.

The nature of the two volumes precludes an adequate analysis of all the valuable material presented though one cannot help the feeling that in considering the disposal of radioactive waste, the hazards are unduly toned down.

The volumes are well produced, comparatively free from typographical errors, and the price quite moderate. These volumes should find a place in the library of every institution of higher studies in chemistry.

S. V. ANANTAKRISHNAN.

*Advances in Protein Chemistry*, Vol. 10. Edited by M. L. Anson, K. Bailey and J. T. Edsall. (Academic Press, New York), 1956. Pp. viii + 425. Price \$ 9.00.

Rapid strides have been made in recent years by scientists investigating different aspects of protein chemistry with the result that biochemists eagerly await the publication of the *Advances in Protein Chemistry* in order to get an authoritative account of the latest advances in this field of scientific endeavour. The volume under review, which is the tenth in the series, has six very good articles on various topics in protein chemistry. Thus, G. E. Perlmann, in discussing the nature of phosphorus linkages in phospho-proteins, has given experimental evidence for the existence of diester and pyrophosphate bonds in proteins. As in the case of the sulphur bridges, the phosphorus in proteins can either link different peptide chains or may serve to connect two sites of a single chain in a cyclic loop. C. E. Dalglish in his article on the metabolism of the aromatic amino-acids has dealt at length on those aspects of the metabolism of phenylalanine, tyrosine and tryptophane not concerned with the synthesis or breakdown of proteins or peptides. Thus, he has given in detail experimental evidence to show that glucose is the precursor of the aromatic ring and is converted to shikimic acid, a common precursor of the aromatic amino-acids. The various pathways by which tryptophane got metabolised in various organisms are also described in detail.

In the third article, J. Steinhardt and E. M. Zaiser have dealt with hydrogen-ion equilibria in native and denatured proteins. The acid-base dissociations of proteins is a subject of fundamental importance and hence this extensive review will prove very valuable. Fish proteins written by G. Hamoir of Belgium provides exhaustive data on proteins in a variety of fishes as also details of various enzymes which split these fish proteins. The next essay on the sea as a potential source of protein food is written by L. A. Walford and C. G. Wilber in a style quite different from those of the rest. In this survey, the authors have, however, brought in certain non-essential considerations, such as the following in p. 296.

"In India, fishermen are close to the bottom of the caste hierarchy. They are wretchedly poor, illiterate, conservative. Those among them who are ambitious try to elevate their status by finding more respected employment as cooks, water-carriers, porters, domestic



servants and so on." In the reviewer's opinion, human nature being what it is, fishermen are the same all the world over, and as in the United States, they do display a general tendency even in India to abandon fishing for 'more comfortable or better paying occupations'.

The last article on zinc and metallo-enzymes by B. L. Vallee is a very good exposition of the subject and deals extensively with zinc containing proteins and enzymes. The get-up of the book is good and only one misprint was detected in p. 239. On the whole, the subjects have been well chosen and presented and are bound to attract the attention of all interested in the chemistry of proteins. P. S. SARMA.

**Terramycin (Oxytetracycline)—Antibiotics Monograph No. 6.** By Merle M. Musselman with the collaboration of H. L. Davis and H. W. Mcfadden, Jr. (Editors: H. Welch and Felic Marti-Ibanez.) (Published by Medical Encyclopædia, Inc., New York, N.Y. Distributors outside U.S.A. Interscience Publishers, Inc.), 1956. Pp. 144. Price \$4.00.

There is such a torrential flow of papers on antibiotics, that one anxious to have a thorough knowledge of the subject is finding it impossible even to cope up with it, let alone assimilate and digest the information. Even the specialist has progressively to cut down the aperture of his field of speciality to remain a specialist all. To those caught in this desperate situation, the *Antibiotics Monograph* edited by Welch and Marti-Ibanez come as a very welcome relief.

The attractive feature of these monographs is that the specialists have given a digest of the particular subject chosen in a very terse and business-like form in a volume which could be gone through in a few hours. The present monograph is one of six already appeared and to be followed by nine more. This monograph on one of the most useful of the antibiotics gives practically all the information about oxytetracycline—the history, physical and chemical properties, the antimicrobial activity, the pharmacology and the principles of therapy, the classical application, the resistance, and reaction to it. The coverage is very thorough, and the density of information very high. The reviewer heartily recommends this monograph to the laboratory research worker, the clinical investigator and above all to the practising physician as the most complete, accurate and practical publication on oxytetracycline. The value to the investigator is enhanced by the inclusion of 650 references covering 14 pages.

K. GANAPATHI.

**Chromosome Botany.** By C. D. Darlington. (George Allen & Unwin Ltd., London), 1956. Pp. xii + 186. Price 16 sh.

This book gives in compact form our present knowledge of chromosomes and the part they play in plant life and is written by one who has made considerable original contributions in this field.

Chapter 1 states what chromosomes are, how they divide and how they are liable to change by crossing over, by inversion, by interchange, by fragmentation or by multiplication (polyploidy). The presence of heterochromatin and the occurrence of B chromosomes are also discussed. In the next chapter the orthodox methods of systematic botany are criticised and a plea made for the use of chromosome studies in taxonomy. In an ideal species the individuals exchange genes freely, i.e., there is cross-breeding, regular meiosis and unrestricted crossing over between homologous chromosomes. The change from cross-breeding to in-breeding may lead to the formation of pure lines or to the production of true-breeding inversion or ring-producing interchange hybrids. Such in-breeding systems have very limited possibilities of evolving further. When autopolyploidy develops in plants, they tend more and more to reproduce vegetatively. Vegetative propagation destroys gene exchange and brings evolution to an abrupt end. At the same time, however, free gene exchange has to be restricted if a new species is to arise within a group either by the geographic or genetic isolation of certain members from the parent group.

Chapter 3 discusses chromosome ecology and chromosome geography. Where within a species there are different races having a wide range in chromosome number, it is sometimes possible, as in *Erophila verna*, to show correlation between chromosome number and the kind of habitat. When polyploids are found within a species, they may occur at the colonising margin of the species, e.g., *Biscutella laevigata*. In fact, such change in chromosome number appears to facilitate colonisation. The basic number of chromosomes within a genus sometimes appears to increase as the species move away from the earlier home of the genus, e.g., in *Leucojum*. In groups where interchange rings appear, e.g., in *Eu-Oenothera*, the ring plants being more recent have moved away from the earlier home of the group where the species are pair-forming.

Chapter 4 deals with the evolution of chromosomes and plant species. Various ways by which chromosomes are altered are discussed.

The importance of allopolyploidy in the production of new species with a different basic number is stressed. On account of the production of allopolyploid species from wide crosses, plant evolution is not merely divaricate in time: it is also reticulate. Chromosome numbers change less in long-lived plants than in short-lived plants, the stability of chromosome number being correlated with the length of the reproductive cycle. Thus in annual plants basic numbers are fixed only for a few thousand generations but in woody plants they are usually fixed for many million years. The polyploids, apomicts and the ring-forming heterozygotes are marked by signs of stereotyping which preclude adaptation and therefore preclude ultimate survival.

The last two chapters are of particular interest to plant breeders as they deal with the history and improvement of our cultivated and ornamental plants. Various methods of improvement open to the plant breeder are discussed.

The book is well illustrated with diagrams and maps. It will be very useful at the post-graduate level to students of cytology, taxonomy and plant breeding. R. P. PATIL.

**Methods in Enzymology, Vol. II.** Edited by S. P. Colowick and N. O. Kaplan. (Academic Press, Inc., Publishers, New York), 1955. Pp. xx + 987. Price \$23.80.

The present volume is the second of a series of four volumes on "Methods in Enzymology". These volumes have been written with the object of making a comprehensive compilation of the methods used in the study of enzymes. The first volume was reviewed in a previous issue of *Current Science* (1956, 25, p. 67). The present volume maintains the general level of excellence and will be greatly welcomed by all active laboratory workers in biochemistry and allied fields. Much stress has been placed on the methodology of enzymes, viz., assay methods, purification and properties, etc., providing an exhaustive guide to investigators in the fields of intermediary metabolism, biochemical aspects of nutrition, mode of action of drugs, etc., to all of which enzymatic processes in cellular function firmly hold the key.

The volume is divided into five sections. The first section, rightly the largest on account of its obvious importance, deals with enzymes of protein metabolism. In the next section on enzymes of nucleic acid metabolism, a detailed enumeration and description of the various processes in this rapidly progressing branch of biochemistry has been made. In particular, the

article on some of the recently developed methods for the study of *de novo* synthesis of purine nucleotides should prove useful to those interested in the study of purine biosynthesis. The other sections dealing with enzymes in phosphate metabolism, coenzyme and vitamin metabolism and respiratory processes likewise give a thorough and up-to-date account of the respective subjects and the progress made.

The publishers should be wholeheartedly congratulated for enlisting a large number of distinguished investigators, each a specialist in the particular subject of his contribution. An equally impressive job has been done by the editors and the advisory board in arranging the articles in such a well-integrated manner. The documentation of the chapters is done well both with regard to the recency and number of references. The volume is indeed a befitting dedication to the memory of the late Dr. James B. Sumner, the pioneer enzymologist.

K. V. GIRI.

#### Books Received

*High Energy Nuclear Physics—Proceedings of the Sixth Annual Rochester Conference*, April 3-7, 1956. Edited by J. Ballam, U. L. Fitch, T. Fulton, K. Huang, R. R. Rau and S. B. Treiman. (Interscience Publishers), Pp. 54. Price \$3.75.

*Annual Review of Biochemistry*, Vol. 25. Edited by J. Murray Luck, Frank W. Allen, Gordon Mackinney. (Annual Reviews Inc., Palo Alto, California), 1956. Pp. vi + 794. Price \$7.00.

*High Polymers*, Vol. XI. (Polyethylene). By R. A. V. Raff and J. B. Allison. (Interscience Publishers), 1956. Pp. xi + 551. Price \$16.00.

*Elementary Practical Geology*. By E. de C. Clarke, R. T. Prider and C. Teichert. (University of Western Australia Press, Nedlands, W. Australia), 1956. Pp. v + 172. Price 27 sh. 6 d.

*Elements of Geology for Western Australian Students*. By E. de C. Clarke, R. T. Prider and C. Teichert. (University of Western Australia, Nedlands), 1956. Pp. xii + 300. Price \$40.

*Changes of State—A Mathematical Physical Assessment*. By H. N. V. Temperley. (Cleaver-Hume Press, Ltd.), 1956. Pp. xi + 324. Price 50 sh.

*Analysis of Bistable Multivibrator Operation—The Eccles-Jordan Flip-Flop Circuit*. By P. A. Neeteson. (Philips Technical Library), India: M/s. Philips Electrical Co., India, Ltd., 7, Justice Chandra Madhab, Calcutta-20, 1956. Pp. 82. Price Rs. 8-12-0.

## PROGRESS IN NUCLEAR ENERGY REACTORS\*

THE Geneva Conference on Atomic Energy resulted in the release of such a vast amount of information, that many attempts have been made to present this information in a compact and easily accessible form. The 'Progress in Nuclear Energy' Series does this in eight volumes, and the present volume is the second of the series and deals with reactors.

The first five chapters of the volume deal with research reactors while the remaining six chapters deal with power and production reactors. The research reactors are dealt with on a territorial basis, each of the chapters describing the reactors in Canada, U.S., U.S.S.R., the European Continent (France, Norway and Sweden) and the U.K.

The research reactors recently built or under construction are mostly of three types. Firstly we have the enriched U-ordinary water heterogeneous reactors of the M.T.R. and swimming pool type. These reactors have generally a small volume and a high power and flux density and are very useful in that they provide not only high thermal fluxes but also high fast fluxes, which are essential for radiation damage studies. There is a detailed description in the book of the design and construction of the M.T.R. and of the determinations of its various characteristics, and briefer descriptions of other reactors.

The other popular type of reactor is the heterogeneous heavy water one using mostly natural and sometimes enriched U. The European and Canadian reactors are all of this type and there are detailed descriptions in the book of the NRX in Canada and of the Chatillon and Saclay piles and of the many reactor physics experiments made with these. These types of reactors give high thermal fluxes and having fairly large volumes, are able to provide extensive experimental facilities. They are also very useful for testing out fuel assemblies and lattice designs for power reactors.

The third type of research reactors described are the homogeneous reactors in the U.S. using enriched U and ordinary or heavy water. These have many advantages but seem unable to give high fluxes.

The second half of the book is devoted entirely to a consideration of existing and proposed power and production reactors. The production part is important inasmuch as it appears that nuclear power will not be competitive with power from other sources unless the production of plutonium or  $U_{233}$  is taken into account. The power reactors in any country ultimately will not consist of a single type but of several types integrated for optimum power and production.

Britain and Russia seem to be interested in developing as soon as possible a reactor which would be able to produce large quantities of electrical power on a commercial scale. It is interesting that they have both pitched upon the graphite-U type as the one which promised quickest immediate development. There is a detailed description in the book of the Calder Hall reactors which have now come into operation. There is no description however of the Downreay fast reactor, which is the other type the British have decided to develop and only a very brief account of the Russian power reactor.

The rest of the book is devoted to a description of the proposed types of power reactors in the United States. The differences between the types lie mainly in the different ways of extracting and utilising the heat produced in the reactor. In the P.W.R. which is described in great detail, the heat transfer is made with pressurised water which attains a high temperature in the reactor without boiling, while in the boiling water reactor, steam is generated in the reactor itself. The P.W.R. is also interesting in that it employs a type of reactor with highly enriched U seeds in natural U assembly. In homogeneous reactors, the whole solution or slurry is circulated. There is a detailed description of the sodium-cooled graphite reactor. There is a discussion of fast reactors without a description of any actual reactor. The possibility of fast power reactors depends largely on high heat transfer performance which is just possible with liquid sodium coolant.

There is a very useful catalogue at the end of all reactors existing, dismantled, building or proposed. There is an interesting foreword by Sir Christopher Hinton.

S. B. D. IYENGAR.

\* Edited by R. A. Charpie, D. J. Littler, D. J. Hughes, and M. Trocheris. (Pergamon Press, New York), 1956. Pp. x + 492. Price 100 s/z.

## SCIENCE NOTES AND NEWS

### *Alternaria zinnæ* Pape. in India

*Zinnia elegans*, a common ornamental plant in Delhi gardens, has been found to be badly damaged by fungus which has been identified as *Alternaria zinnæ* Pape. Messrs. B. L. Chona and J. N. Kapoor, Division of Mycology and Plant Pathology, I.A.R.I., New Delhi, report this for the first time from Northern India.

### Utilisation of Plutonium

In a recent speech, Willard F. Libby, Commissioner, Atomic Energy Commission, U.S.A., urged chemists to learn a way of adapting the plutonium in atomic weapons for peaceful power uses. He challenged scientists to discover a way to "burn up" plutonium for fuel, should the day come when the weapons stockpile is considered large enough.

The fact that plutonium is highly dangerous has so far hindered its use in power development. Plutonium, like radiostrontium, emits alpha rays and accumulates in human bone. The need for increased safety precautions has so far made plutonium less attractive to experiment with than enriched uranium-235, the current source of power fuel.

### Aluminium with the Hardness of Steel

A new method of electrolysis, known as hard or deep anode treatment, has been elaborated by Professor N. D. Tomashev and M. N. Tyukina, at the Institute of Physical Chemistry of the USSR Academy of Sciences, which makes it possible to obtain an oxide layer of extreme hardness, firmly bound with the basic metal, on the surface of aluminium and its alloys. The thickness of this layer may be 100-150 microns and more, this being several times the thickness obtained by previous methods. The thick anode film obtained by this method considerably increases the resistance of aluminium alloys to wear and friction. Furthermore, it lends the surface heat-resistance and electric insulating properties, capable of standing a tension of 2,000 volts.

### Rocket Flight Around the Moon

Professor Chebotarev, of the Institute of Theoretical Astronomy of the USSR Academy of Sciences, has established the theoretical possibility of sending up a rocket for a flight

around the moon and the return to earth, carrying a smaller amount of fuel than has hitherto been considered necessary. Professor Chebotarev's calculations have shown that the rocket only needs fuel during the first period of its flight, after which it will continue to move under the influence of the gravity of the moon, sun and earth.

According to these computations, the rocket will travel a maximum distance of 400,000 km. from the earth. The distance between the earth and the moon is 384,000 km. The velocity of the rocket will drop from 11 km. per second at the start to nought as it approaches the moon. Thanks to this, the rocket will fly round the moon, thus making it possible to observe that planet from the side not visible from the earth. The entire flight will take 10 days and nights.

### Genetics Congress Resolution on Radiation Hazards

At the final session of the International Congress of Human Genetics which met recently in Copenhagen, Denmark, Herman J. Muller, of the University of Indiana, proposed the following resolution on radiation danger. It was passed unanimously by the approximately 400 participants.

"The damage produced by radiation on the hereditary material (of man) is real and should be taken seriously into consideration in both the peaceful and military uses of nuclear energy as well as in all medical, commercial and industrial practices in which X-rays or other ionizing radiation is emitted.

"It is recommended that the investigation of the amount and type of damage and of related genetic questions be greatly extended and intensified with a view of safeguarding the well-being of future generations."

### Scientific Aid to Fishing

The latest addition to the fisherman's scientific armoury, the Kelvin Hughes Fisherman's Asdic, will be on the world's markets about the middle of next year. It is a new application of the technique of transmitting acoustic pulses which rebound from solid bodies and are recorded back in the boat. An expert operator can interpret from the blips and smudges not only that he is passing over a shoal, but

how many fathoms down it is, and even what type of fish.

With the Asdic, used in conjunction with new types of vertical echo sounders introduced simultaneously by the same firm, the chance of a slip between tin and blip appears to be materially reduced; for the Asdic transmits horizontal pulses which will reveal the positions of shoals anywhere round the boat up to 2,000 yards range.

### Physics and Chemistry of Solids

The publication of an international research journal with the above title has been announced recently. The Journal will publish both theoretical and experimental papers dealing with original research in all aspects of the physical and chemical properties of solids and condensed systems. The principal fields of interest, however, will centre on (1) the electronic structure of solids and those physical and chemical properties which derive more or less directly from electronic structure, and (2) the fundamental statistical mechanics of condensed systems. Preference will be given to those contributions having the widest significance for the understanding of solid state properties in general, and emphasis will thus be on topics with some theoretical implications. The aim of the Journal is to bring together into a common forum the best contributions on the physics and chemistry of the solid state from all over the world. As in the case of *ACTA METALLURGICA*, it is a part of the purpose of the Journal to encourage greater interchange of ideas between physicists and chemists interested in solids. Other particulars can be had from the Editor-in-Chief, Professor Harvey Brooks, 224, Nyman Laboratory, Harvard University, Cambridge 38, Massachusetts, U.S.A.

### Institution of Telecommunication Engineers, India

The first Technical Convention of the Institution of Telecommunication Engineers, India, will be held on December 30, 1956, at the National Institute of Sciences Hall in New Delhi.

The Convention will be preceded by the Annual General Meeting of the Institution on

December 29, when Brig. Iyappa, the present President, will hand over charge of his office to the President-Elect, Prof. K. Sreenivasan, Head of the Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore.

At the Technical Convention, a number of papers on various aspects of telecommunication are expected to be presented. Those participating actively in the Convention include the National Physical Laboratory, Indian Institute of Science, Government Communication agencies such as All-India Radio, Posts and Telegraphs, State Industrial enterprises like Bharat Electronics and various Universities and colleges. The Convention, which is expected to be an annual feature, will provide for the first time in the country, a forum for all those working in the field of telecommunications to present papers and exchange information on topics of mutual interest.

### Royal Institute of Chemistry, North India Section

At the Annual General Meeting of the North India Section of the Royal Institute of Chemistry held recently, the following Office-bearers were elected for the year 1956-57. *President*: Dr. B. Viswanath; *Hon. Secretary and Treasurer*: Dr. G. S. Saharia; *Auditor*: Mr. B. N. Sastri.

### Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Chemistry to Shri D. Subrahmanyam for his thesis entitled "Some Studies in Cerate Oxidimetry".

The Gujarat University has awarded the Ph.D. Degree in Physics to Shri Shah Govindlal Zaverbhai for his thesis entitled "Nuclear Scattering of High Energy Nucleons".

The Madras University has awarded the Ph.D. Degree in Physics to Shri P. M. Mathews for his thesis entitled "On the Application of Some Recent Methods in Stochastic Theory to Physical Problems".

The Utkal University has awarded the Ph.D. Degree in Chemistry to Shri Hrushi Kesh Pujari for his thesis entitled "Preparation and Useful Applications of Some Thiazolidone Derivatives".

# Current Science

Vol. XXV]

DECEMBER 1956

[No. 12

	PAGE		PAGE
<i>Quantum Theory and Crystal Physics—</i> SIR C. V. RAMAN .. .. .	377	<i>Nobel Award for Chemistry—1956—</i> M. SANTHAPPA .. .. .	387
<i>Chromosome Breakage Induced by Vegetable Oils and Edible Fats—</i> M. S. SWAMINATHAN AND A. T. NATARAJAN ..	382	<i>Nobel Award for Physics—1956—</i> K. S. CHANDRASEKHARAN .. .. .	388
<i>UNESCO'S First Ten Years</i> .. .. .	384	<i>Catalogue of Nuclear Reactors</i> ..	388
<i>Growth of the Sand Bar North of the Godavari Confluence—</i> C. MAHADEVAN AND R. PRASADA RAO .. .. .	385	<i>Letters to the Editor</i> .. .. .	389
		<i>Reviews</i> .. .. .	405
		<i>Progress in Nuclear Energy—</i> K. S. SINGWI AND L. S. KOTHARI .. .. .	408
		<i>Science Notes and News</i> .. .. .	409

## QUANTUM THEORY AND CRYSTAL PHYSICS\*

By

SIR C. V. RAMAN

### 1. INTRODUCTION

THE physics of the twentieth century differs fundamentally from the physics of the nineteenth mainly because of two theories known respectively as the Quantum Theory and the Theory of Relativity which form an integral part of its scheme of thought. It is these two theories that have enabled a far deeper understanding of the nature of the physical world to be attained than was possible at the end of the last century. One must here acknowledge the

work of Albert Einstein who played the leading role in the development of both of these theories. His publications during the first two decades of the present century bear on every page the imprint of a powerful and penetrating intellect. Even after this lapse of years, the physicist of today will find the study of those papers a profitable and stimulating experience. Indeed, a good deal of what I have to say in this address only reflects the results of such a study in relation to the fundamental problems of the crystalline state of matter—a subject which has deeply interested me for several years past.

\* Presidential address to the Indian Academy of Sciences, at Waltair, on the 26th December 1956.

## 2. ORIGIN OF THE QUANTUM THEORY

The quantum theory arose from the attempt to explain the characters of the radiation which emerges from the window of an enclosed furnace heated to high temperatures. As is well known, the total intensity of such radiation increases rapidly with rise of temperature of the furnace. Simultaneously, there is a shift of the spectral maximum of intensity towards higher frequencies, as is indeed evident from the progressive change in colour of the radiation. Thermodynamic considerations indicate that this shift should occur in such a manner that the spectral frequency at the point of maximum intensity should be directly proportional to the absolute temperature of the furnace. Quantitative measurements confirm that this is the case and show that the changes in the intensity as well as in the spectral character of the radiation with rise of temperature agree with a formula for the spectral intensity in which the cube of the spectral frequency appears multiplied by an exponential function of a type made familiar by Boltzmann's well-known principle. The argument of the exponential function is negative and has as its numerator the spectral frequency multiplied by one universal constant and as its denominator the absolute temperature multiplied by another universal constant. A small but important modification secures a much more satisfactory agreement between the formula and the facts of observation. In the modified expression, the exponential has the same argument with a positive sign and now appears in the denominator with unity subtracted from it. This is the celebrated Planck formula except for a multiplying numerical factor.

## 3. EINSTEIN'S DERIVATION OF THE PLANCK FORMULA

Einstein gave a physical interpretation of the Planck formula and also showed how the formula could be derived on the basis of simple physical considerations. He in-

terpreted the formula to mean that radiation of all frequencies is emitted and absorbed by material bodies in discrete quanta of energy proportional to their respective frequencies. He also showed that the radiation formula follows very naturally if we assume that the energy of the material particle which emits the radiation is itself quantised, in other words, its energy of vibration alters by successive steps, each of which is equal to the quantum of radiation energy which is emitted in the process.

A more complete and logically satisfying derivation of the Planck radiation formula was given by Einstein ten years later, *viz.*, in 1917. In that paper, the notion of probability which in the quantum theory replaces the determinism of the older physics finds a prominent place. Instead of assuming the radiator to be a harmonic oscillator as in his paper of 1907, Einstein dealt with the most general case of an oscillator which has a number of discrete energy levels. The probability of its being present in any one of them is expressed by the product of the inherent statistical weight characteristic of the level multiplied by the appropriate thermodynamic probability factor. The latter takes the form of an exponential function with a negative argument equal to the energy of the state divided by the product of the absolute temperature and the Boltzmann constant. Einstein then considers the probability of three different kinds of elementary processes occurring in any given small time interval. The first is a spontaneous transition from the higher to a lower state of energy with emission of radiation as contemplated in Bohr's theory of spectra; the second is a transition of the same nature but now induced by the presence of an external radiation field; the third is a transition from the lower to the higher energy state also induced by the external field. The probabilities of the two latter transitions are taken as proportional to the energy density in the surrounding radiation

field. A transfer of energy from the oscillator to the field and an absorption of energy from the field by the oscillator are involved respectively in the two processes. In a steady state of affairs, the probabilities of transition in the two opposite directions must necessarily balance each other. These considerations lead at once to the Planck radiation formula.

#### 4. THE CRYSTAL AS AN ASSEMBLY OF OSCILLATORS

The foregoing exposition of Einstein's original ideas is intended to furnish a theoretical background for a consideration of the fundamental properties of the solid state which is the subject of the present address. Elementary processes closely analogous to those contemplated in Einstein's paper of 1917 successfully describe the phenomena actually observed when a beam of monochromatic light traverses a crystal and the light diffused in its interior is examined spectroscopically. We observe in the spectrum of the scattered light sharply defined lines with frequencies both higher and lower than that of the incident radiation. The ratio of the intensities of each such pair of lines having equal spectral displacements in opposite directions is found to be expressed correctly by a Boltzmann factor corresponding to the change of frequency multiplied by Planck's constant, this again being multiplied by the fourth power of the ratio of the two spectral frequencies. These facts indicate that the displaced frequencies arise from transitions from a higher to a lower energy state and *vice versa* induced in the elementary oscillators comprised in the crystal by the incident radiation. We are thus naturally led to regard the crystal as an assembly of a great number of oscillators which form a system in thermodynamic equilibrium. The thermal energy of the crystal may then be equated to the sum of the thermal energies of all the oscillators of the different sorts of which it is composed.

It is evident from what has just been stated that the specific heats of crystals stand in the closest relation to their spectroscopic properties. The first step in the theoretical evaluation of the thermal energy of the crystal is accordingly to identify and enumerate the oscillators of which it is composed and to discover and specify the energy states which they can occupy.

#### 5. THE OSCILLATORS AND THEIR ENERGY LEVELS

To begin with, we may provisionally identify the oscillators with whose behaviour we are concerned with the groups of atoms present in the unit cells of the crystal structure. To discover the energy levels which these oscillators can occupy, we may, at least in regard to the infra-red or vibrational levels, adopt the same procedure as that which has proved itself abundantly successful in the field of molecular spectroscopy. As is well known, that procedure consists in determining and enumerating the different possible modes of vibration in each one of which the atoms all vibrate with the same frequency and in the same or opposite phases.

In endeavouring to carry through the procedure indicated above, the difficulty immediately presents itself that the group of atoms present in any one unit cell of the crystal structure is not isolated but forms a connected system with the groups of atoms in the surrounding cells and these latter again are connected with groups of atoms further out and so forth. The mathematical and physical difficulties which present themselves by virtue of these interconnections disappear when we make use of the fundamental property of crystal structure, *viz.*, that it comes into coincidence with itself following a unit translation along any one of its three axes. Hence any normal mode of vibration should also possess the same property *viz.* it remains a normal mode following a unit translation of the crystal. This requirement immediately enables us to



determine and enumerate the normal modes in the most general case of a crystal consisting of several interpenetrating Bravais lattices of equivalent atoms. It emerges that the normal modes are divisible into two classes; in the first class, the amplitudes as well as the phases of oscillation of equivalent atoms in adjoining cells of the lattice structure are identical, while in the second class of normal modes the amplitudes of equivalent atoms are the same but the phases are reversed along one or two or all three of the axes of the lattice. If the crystal consists of  $p$  interpenetrating Bravais lattices, there are  $(3p - 3)$  normal modes of the first class and  $21p$  modes of the second class.

Thus the result emerges that the vibrational energy levels of a crystal form a sharply defined set in much the same manner as the vibrational energy levels in the spectra of molecules. But this result would necessarily be modified when the effects of anharmonicity and the interactions of the different normal modes with each other are taken into consideration.

## 6. THE SPECTROSCOPIC BEHAVIOUR OF CRYSTALS

The theoretical results stated above are in complete agreement with the actual spectroscopic behaviour of crystals in the infra-red region of frequencies as revealed by diverse techniques of observation in appropriate physical conditions. For example, they furnish an immediate explanation of the spectroscopic effects exhibited by crystals in the scattering of monochromatic light as mentioned earlier. In some cases the energy levels are shown by the spectral shifts to exhibit a lack of sharpness. That this arises from the disturbing effects of anharmonicity is demonstrated by cooling down the crystal to liquid-air temperature. The energy levels then become perfectly sharp, as is to be expected. We need not dilate here upon the different techniques

of spectroscopic observation which are available only in particular cases. Mention should be made, however, of the very general method of observing the energy levels in crystals by the techniques of infra-red absorption. These latter have been greatly improved of recent years and the results obtained with such improved techniques completely confirm the theoretical findings stated above.

A feature of special interest to which reference may be made here is in respect of the possibility of observing the  $21p$  normal modes of the second class in which the phases of oscillation are opposed in adjoining cells of the crystal structure. It is to be expected that by reason of such opposition of phase these modes would be precluded from observation by any of the available methods of spectroscopic study. Fortunately, however, and for reasons which I shall not here dilate upon, this is not invariably so. The normal modes of the second class are actually accessible to observation in several cases and they then manifest themselves as discrete and sharply defined lines in the spectra, provided the effects of anharmonicity are either absent or else are suppressed by the use of adequately low temperatures. Their appearance is one of the most striking vindications of the correctness of the present theoretical approach.

## 7. THE SPECIFIC HEATS OF CRYSTALS

Regarding a crystal as an assembly of an immense number of oscillators in thermodynamic equilibrium, the evaluation of its thermal energy as a function of the temperature reduces itself to the problem of classifying and enumerating the different sorts of oscillators comprised in it and determining the scheme of energy levels for the oscillators of each sort. An application of Boltzmann's principle then enables us to evaluate the average energy of an oscillator of that sort, and multiplying it by the number of

such oscillators we obtain a sum total; the addition of the sums thus found for the different sets of oscillators gives the total thermal energy of the crystal. By differentiating this total with respect to the temperature, we obtain the specific heat of the crystal.

As already stated, we have  $(3p - 3)$  normal modes of vibration of the first kind and  $21p$  normal modes of the second kind. Thus, we have  $(24p - 3)$  modes and frequencies in all and these have equal statistical weight. They may be regarded as the internal modes of vibration of the  $8p$  atoms contained in a volume element of the crystal whose dimensions are twice as large in each direction as the unit cell of the crystal structure. The three omitted degrees of freedom represent the translatory movements of these groups of  $8p$  atoms each. If we leave the latter aside for a moment and also neglect the effects of anharmonicity, the specific heat of a crystal may be expressed very simply as the sum of  $(24p - 3)$  Einstein functions, each involving its own characteristic frequency; the total number of oscillators which contribute is the number of groups of  $8p$  atoms each comprised in the crystal. To this sum must be added the contribution to the specific heat arising from the oscillations inside the crystal which are attributable to the translatory movements of these groups of  $8p$  atoms each. In a paper which has appeared in the October issue of the *Proceedings* of the Academy, it has been shown how the latter contribution may be rigorously evaluated. The argument by which this is effected may be very simply stated. The translatory movements of the groups of  $8p$  atoms each give rise to oscillatory movements in volume elements which comprise a still larger number of atoms. By

taking a succession of volume elements of different sizes and taking note of the circumstance that the lower limit of frequencies of vibration thus arising would diminish in proportion to the increasing dimensions of the volume element, the spectral distribution of frequencies follows immediately. Their contribution to the thermal energy of the crystal is found to be expressible as an integral having a well-known form involving Einstein's expression for the average thermal energy of a harmonic oscillator.

It may be mentioned in conclusion that the method sketched above has been successfully applied to the evaluation of the specific heats of crystals—including especially diamond and the metallic elements—down to the very lowest temperatures approaching absolute zero. The theory emerges triumphantly from the test.

#### 8. SUMMARY

The fundamental notions of quantum theory and thermodynamics indicate that a crystal should be regarded as an assembly of an immense number of oscillators whose energy states are quantised and which form a system in thermodynamic equilibrium. They also indicate that the spectroscopic properties and the thermal behaviour of crystals stand in the closest relation to each other. We are thus left with the problem of discovering and enumerating the oscillators of the different sorts comprised in the crystal and of determining their scheme of energy levels. This may be done by methods analogous to those which have proved successful in the field of molecular spectroscopy. The results obtained are in perfect agreement with the observed spectroscopic properties and thermal behaviour of crystals.

CHROMOSOME BREAKAGE INDUCED BY VEGETABLE OILS  
AND EDIBLE FATS

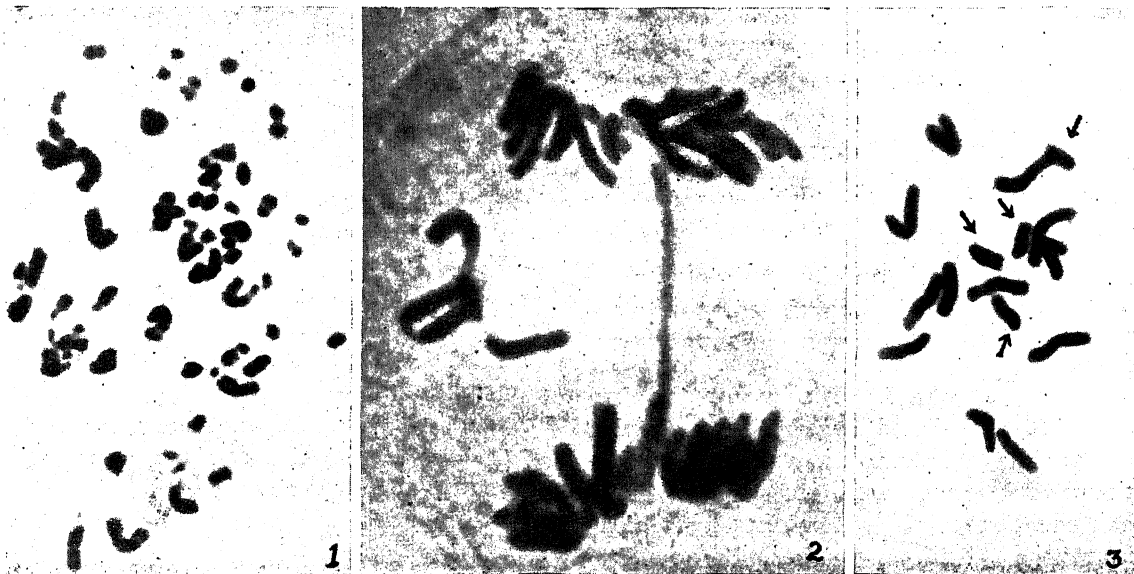
M. S. SWAMINATHAN AND A. T. NATARAJAN

Indian Agricultural Research Institute, New Delhi

DURING the course of mutation research in progress at the Indian Agricultural Research Institute, the earlier findings of Gustafsson<sup>1</sup> and other workers that there are marked differences in sensitivity to radiation among different crop plants was confirmed.<sup>2</sup> It was found that some oilseed plants like linseed are much less sensitive to radiation with X-rays and  $\beta$ -particles from  $^{32}\text{P}$  and  $^{35}\text{S}$  than cereals like wheat and paddy. It was considered likely that the presence of oil in seeds might have a buffering effect on radiation, and in an experiment designed to elicit information on this problem, seeds of several plants were first soaked in some vegetable oils and edible fats and later subjected to irradiation. In this experiment, controls with no treatment and with seeds soaked in oils for various durations but not subsequently irradiated were kept. Observations on preparations of root tip mitosis made from this material showed that immersion in the oils alone caused chromosome

breakage in many cells. A summary of the results is presented in this paper.

Dry seeds of *Triticum monococcum*, *T. dicoccum*, *T. aestivum*, *Oryza sativa* and *Vicia faba* were soaked for different durations extending from 6 minutes to 6 hours in the following oils and fats (the pure oils had been extracted at the Division of Chemistry of this Institute): mustard oil from *Brassica campestris* var. *toria*, groundnut oil, castor oil, gingelly oil, coconut oil, linseed oil, hydrogenated groundnut oil and ghee. After being soaked in oil, the seeds were thoroughly wiped with cloth and sown in petri-dishes over moist filter-paper. Soaking for two or more hours in linseed oil and groundnut oil completely inhibited the germination of seeds. Germination was reduced to varying extents in the other treatments. Root tips were fixed 24, 48 and 96 hours after germination in a mixture of 3 parts of alcohol and 1 part of acetic acid for a day and later stained with leuco-basic



FIGS. 1-3. Mitosis in *T. monococcum* root tips treated with oils. Fig. 1. Mustard oil treatment for 2 hours showing extreme chromosome fragmentation. Fig. 2. Anaphase in mustard oil treated cell with one dicentric bridge and a point error configuration. Fig. 3. Castor oil treatment for two hours showing 12 chromosomes and 4 fragments (arrows). Note that the treatment leads to the contraction of chromosomes, thus facilitating their spread.

(Figs. 1 and 3,  $\times 900$ ; Fig. 2,  $\times 1800$ .)

fuchsin and squashed. Preparations were also made from control seeds sown either dry or after soaking in water for 2 to 6 hours.

Cell division was normal in the root tips of control seeds. Analysis of metaphase and anaphase plates in preparations made from treated root tips showed several aberrations like chromosome and chromatid breakages, minute fragments, dicentric bridges and acentric fragments and 'error' bridges probably arising from subchromatid breakages<sup>3</sup> (Figs. 1 to 3). Treatment with the oils, especially castor oil, led to the contraction of chromosomes thereby facilitating their clear spread in squash preparations.<sup>4</sup> No stickiness among the chromosomes was caused by the treatment. In several cells, the two chromatids of a chromosome were asymmetrically broken, thus indicating that they were separately and independently affected. There was also practically no reunion among the chromosome fragments. These observations would indicate that breakage occurs near to the time of chromosome reduplication and also is spread over a period of time. There were some tetraploid cells in the treated root tips, which appeared to have arisen by failure of cytokinesis, since there was no evidence of interference with anaphase movement. Binucleate cells were present lending support to the view that cell division was disturbed. Some binucleate cells showed non-synchronised mitosis, one nucleus being at the resting stage and the other at prophase or metaphase.

The standard *Allium* test of Levan<sup>5</sup> was performed using mustard and gingelly oils and it was found that mustard oil treatment for half to one hour caused the formation of tumours in *Allium* root tips and also induced chromosome breakage. The recovery of the cells from the effects of the treatment was, however, rapid and meristems developed subsequently to the treatment hardly showed aberrant cells. In comparison with mustard oil, gingelly oil had no adverse effects on *Allium* root tip cells.

The data obtained from *T. monococcum* seeds treated with the different oils and fats are summarised in Table I. It will be seen from this table that groundnut and mustard oils produce the largest and gingelly oil and ghee the lowest number of aberrant cells. Such diverse action probably arises from the differences in the fatty acid components of these oils, since we found that very few cells are affected when seeds are treated with glycerol. Auerbach<sup>6</sup> reported that the essential oil of mustard (allyl-iso-thiocyanate) had mutagenic properties but she was doubtful whether it produced chromosome aberrations. It was subsequently shown by D'Amato and Avanzi<sup>7</sup> that allyl-iso-thiocyanate is not capable of producing chromosome breakage. It is reported from studies in *Drosophila* that gingelly oil<sup>8</sup> and groundnut oil<sup>9</sup> have no mutagenic properties. We are now engaged in studying the number of division cycles over which the aberrations are carried forward and the cytological effects of the fractionated components of different fats and oils.

TABLE I  
Chromosome breakage induced in *Triticum monococcum*

Treatment	Duration of treatment	Percentage of germination	Metaphase			Anaphase		Cells with aberrations (per cent.)
			No. of cells studied	No. of cells with aberrations	Range of breaks per cell	No. of cells studied	No. of cells with aberrations	
Water	.. 2 hrs.	100	Numerous	nil	..	..	..	..
Mustard oil	.. 6 mts.	70	267	29	1-18	115	12	10.7
"	.. 2 hrs.	40	213	52	1-21	141	20	20.3
"	.. 6 hrs.	20	486	102	1-24	245	49	22.6
Groundnut oil	.. 1 hr.	20	149	46	1-28	61	6	24.8
"	.. 2 hrs.	0	..	..	..	..	..	..
Castor oil	.. 2 hrs.	40	97	15	1-16	24	4	16.5
Linseed oil	.. 1 hr.	20	75	13	1-7	61	4	12.5
"	.. 2 hrs.	0	..	..	..	..	..	..
Hydrogenated groundnut oil	.. 2 hrs.	20	60	10	1-21	53	3	11.8
Coconut oil	.. 2 hrs.	80	205	29	1-38	294	27	9.2
Gingelly oil	.. 2 hrs.	50	123	3	1-2	137	2	1.9
"	.. 6 hrs.	20	182	16	1-28	168	3	5.4
Ghee	.. 2 hrs.	80	107	7	1-5	109	3	4.7

The results will help to find out whether oils like those of mustard, groundnut and castor can be used for inducing mutations in plants and to isolate the component of the oil which causes the chromosome breakage. Since the mustard oil group consists of several types with varying pungency, the action of each of them is being separately estimated.

The results presented in this paper are of great interest in view of the relationship between mutagenicity and carcinogenicity. The discovery of the mutagenic effect of ionizing radiation, an agent already known to be carcinogenic, provided the first evidence in support of the somatic mutation hypothesis of malignancies. Muller<sup>10</sup> has pointed out that a comparative survey of the results not only with radiations of different types but also with chemical mutagens suggests the view that the effects of these agents on genes and chromosomes forms the basis of their effects in producing malignancies. The role of nutrition with reference to the incidence of cancer is now widely realised and there are indications that a search for carcinogenic compounds in human dietary regimens might be worthwhile. Many fats and oils are known to be capable of promoting and inducing the formation of skin and mammary tumours in rats. Differences in the action of the different oils have also been observed. Thus, increasing the corn oil content from 5% to 20% of the diet strikingly enhanced tumour formation in rats but replacing the 5% corn oil with 20% partially hydrogenated cotton seed oil or 20% lard produced no appreciable augmentation.<sup>11</sup> Such differential action of different fats has not yet been explained in terms of their chemical, physical or biological pro-

perties. Whether there are differences in the action of these oils on the nucleus, similar to the observations recorded by us, remains to be ascertained.

The present study has been carried out only in plant meristems, and it is not known whether comparable effects will be produced in dividing animal tissues. There is, however, evidence that the action of chemical mutagens such as nitrogen mustard, like that of radiation, is general and organisms of various kinds like bacteria, fungi, higher plants and mammals are equally affected.<sup>10</sup> In view of the fact that some of the oils and fats mentioned in this paper are widely used as cooking media in tropical countries, the present data deserve the attention of medical and cancer research workers.

We are indebted to Dr. B. P. Pal and Dr. S. M. Sikka for their interest in the study and encouragement.

1. Gustafsson, A., *Hereditas*, 1944, **30**, 165.
2. Sikka, S. M. and Swaminathan, M. S., *Science and Culture* (in press).
3. LaCour, L. F. and Rutishauser, A., *Chromosoma*, 1954, **6**, 696.
4. Swaminathan, M. S. and Natarajan, A. T., *Stain Techn.* (in press).
5. Levan, A., *Proc. 8th International Genetics Congress, Hereditas Suppl.*, 1949, 325.
6. Auerbach, C. and Robson, J. M., *Nature*, 1944, **154**, 81.
7. D'Amato, F. and Avanzi, M. G., *Caryologia*, 1949, **1**, 175.
8. Demerec, M., *Genetics*, 1948, **33**, 337.
9. Bird, M. J., *Nature*, 1950, **165**, 491.
10. Muller, H. J., *Radiation Biology*, 1954, **1**, 351.
11. Tannenbaum, A. and Silverstone, H., *Advances in Cancer Research*, 1953, **1**, 451.

## UNESCO'S FIRST TEN YEARS

**A**N account of UNESCO's achievements over the first decade of its existence is given in an illustrated booklet published by the Organisation under the title, "Ten Years of Service to Peace". It assesses the contribution made in various branches of education, the sciences and the arts towards better understanding between nations.

This contribution is translated into a wealth of facts and figures. For instance, on UNESCO's initiative, more than 10,000 libraries in over 100 countries and territories are now exchanging publications. International fundamental education centres set up by UNESCO in Patzcuaro (Mexico) and Sirs-el-Layyan (Egypt) have already trained more than 300 teachers in

methods of improving life in rural areas. These teachers are now passing on their knowledge to others in remote parts of their countries in Latin America and the Middle East. More than 3,000 workers representing almost every trade have, through the Exchange of Persons programme, had an opportunity of visiting their counterparts in other lands. Through UNESCO's share in the United Nations Technical Assistance Programme, over 450 fellowships have been awarded to young men and women from less developed regions to train as engineers and scientists. The booklet provides many other examples of what UNESCO is doing to assist countries in solving their educational, scientific and cultural problems.

# GROWTH OF THE SAND BAR NORTH OF THE GODAVARI CONFLUENCE

C. MAHADEVAN AND R. PRASADA RAO

*Dept. of Geology, Andhra University, Waltair*

**L**A FOND AND PRASADA RAO<sup>1</sup> in their detailed paper on the erosion at Uppada attributed the erosion to the alteration of the circulation pattern in the Kakinada Bay as well as near Uppada caused by the growth of the Godavari Point. The sand bar which was non-existent a hundred years ago has grown first northwards of the Godavari confluence, and later towards north-west. It is interesting to study the factors responsible for the development of the sand spit. Most of the river mouths on the east coast of India are characterised by the existence of sand bars extending usually northwards. A person flying from Madras to Calcutta may notice several such sand spits. This is believed to be due to the presence of strong northerly currents, coastal and longshore. The southerly currents caused by the north-east monsoon are too weak to build sand spits in a southerly direction at the confluences.

Poornachandra Rao and Mahadevan<sup>2</sup> found that between Godavari Delta and Waltair, the offshore sediments contained green pyroxene, amphibole and plagioclase in small amounts when compared with garnet and zircon which are present in appreciable amounts. Colourless mica and kyanite also appeared. The detrital mineral assemblages vary in their proportion of quartz, feldspar, sillimanite, zircon, garnet, monazite, bluish green amphibole and plagioclase feldspar. This mineral association is characteristic of the rock types occurring in the drainage basin of the Godavari River. Hence it is believed that most of the sediment in this region is brought by the river.

All the earlier surveys made in the area were consulted, for a detailed analysis of the changes in the region of the Godavari River distributaries. Some of the charts are reproduced and are shown in Plates I, II and III. Plate I shows that Godavari Point was not existing in the year 1851. The present Kakinada Bay was mostly dry during the low waters. The Godavari River discharged its water through an opening towards east. A small sand bar exposed only at low tides was present. The shape of this shows an unmistakable northerly drift of sand at that time. By 1864 the 'sand bar' exposed at low tides became a full-fledged sand spit, resulting in the birth of the Godavari Point. The river was discharging its waters mainly northwards, although a small opening

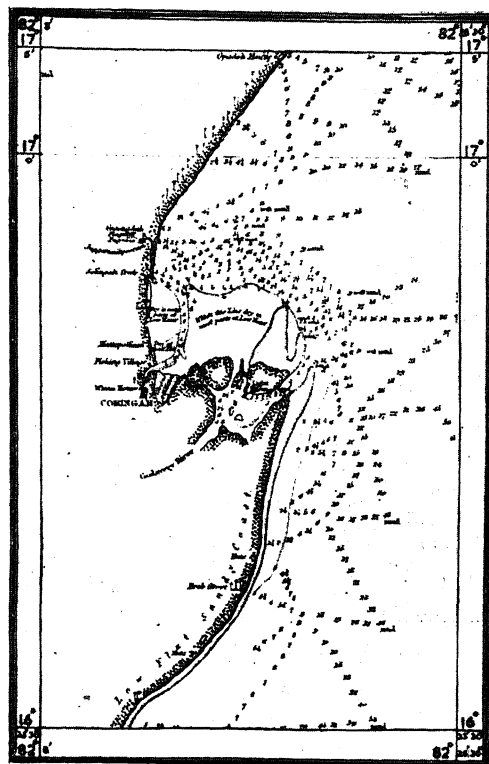


PLATE I. Admiralty Chart of the survey made in 1851, in the region of Godavari Distributaries and Coringah (Kakinada) Bay.

eastward was present at the time. During this period, the Hope Island took its present shape. A bay off Kakinada Town was formed which was previously known as Coringah Bay and now called Kakinada Bay. The bay appeared to have become deeper, the low mud flats were cut probably by the Godavari discharge.

The Godavari Point grew northwards by 1878 and the river was discharging its waters into the Kakinada Bay instead of directly into the sea, since the eastern channel has been completely silted up. The Sacramento Shoals (10 miles south of Kakinada) were slowly appearing by that time. A process of siltation was taking place north of Kakinada groyne. The subsequent charts upto 1893 show a still further development of Godavari Point northwards, the formation of Sacramento Shoals, and the accretion of sand north of the Kakinada groyne. The Godavari Point finally grew

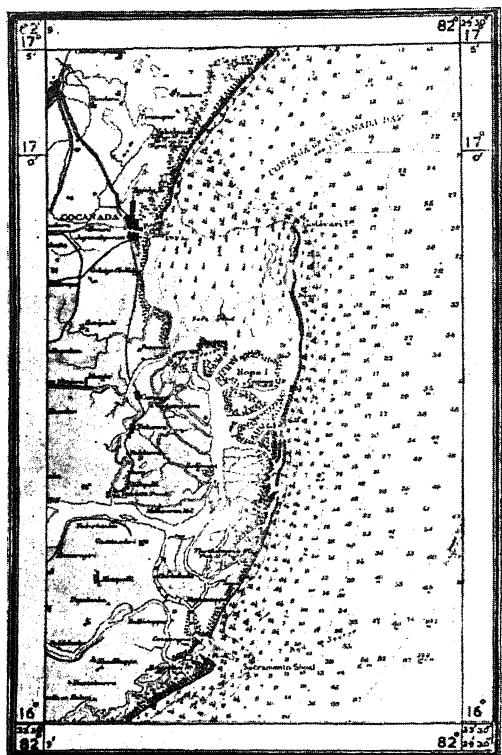


PLATE II. Chart of the survey made in 1893.

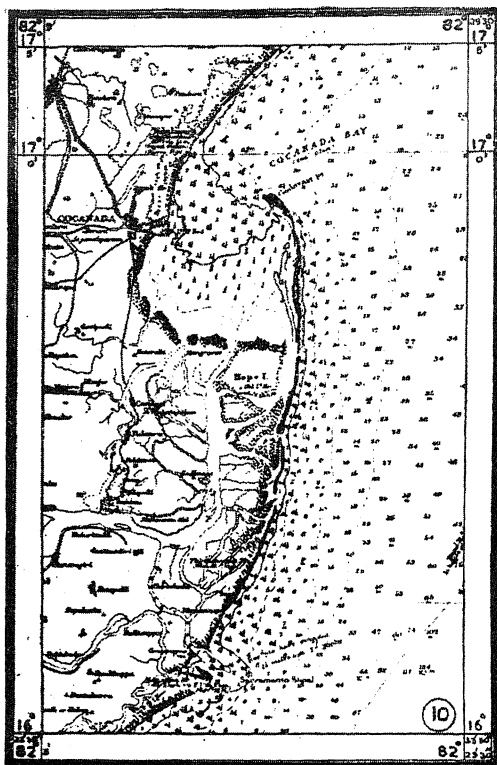


PLATE III. Chart of the survey made in 1929.

towards north-west as the chart of 1929 (Plate III) and the subsequent ones reveal.

The birth and further development of the Godavari Point must have been due to a disturbance of equilibrium caused either on the shore itself or in the river basin. About half a century back, the Madras harbour was constructed. But the structure is too far away (about 300 miles) southwards from the Godavari confluence to have any influence over it. The construction of a breakwater at Visakhapatnam about 25 years back too could not have any effect at the river mouth, firstly since the southerly currents are too weak and secondly the shore structure is a hundred miles north-east of the area under investigation. Obviously no structure built on the coast near about a few hundred miles to the locality had resulted in any disturbance of the equilibrium. Hence changes in the environment in the Godavari Basin itself have to be sought for explaining the development of the sand spit. At Madras, a million tons of sand passes a given point every year along the coast. The same quantity of sand is found to migrate at Visakhapatnam too. This shows that if a sand spit

were to be built, a surplus sediment exceeding the normal limits ought to be supplied to the coast by the river.

A dam constructed a century back at Dowlaishwaram on the river actually ought to have reduced the supply of sediment towards sea. At California, the construction of a number of dams for flood control across the rivers resulted in an inhibition of the supply of sediment to the sea, as a consequence of which the beaches became narrower.<sup>3</sup> At any rate the birth of the Godavari Point a hundred years ago can be ascribed to a surplus sediment made available during a flood time probably owing to heavy rainfall. The growth of the Point later, however, cannot be attributed entirely to repeated floods. The extensive deforestation that has been carried out during the last hundred years and more particularly from the beginning of the century resulted in an increase of soil erosion in the river basin and a net rise in the rate of transport of sediment to the sea. The excessive supply of sediment resulted in the overloading of the littoral drift which already was of the order of a million tons. This surplus sediment was forcibly

deposited north of the river mouth, since the currents are not capable enough to carry it farther up, thus affecting the rapid growth of the sand spit which culminates in the Godavari Point.

The financial assistance of the Council of Scientific and Industrial Research is thankfully acknowledged.

1. La Fond, E. C. and Prasada Rao, R., *The Port Engineer*, 1956, 5(2), 4-9.
2. Poornachandra Rao, M. and Mahadevan, C., *International Geological Congress*, 1956, XX Session, Sec. 14.
3. Caldwell, M. J., *Tech. Mem. 68, Dept. of the Army, Corps of Eng. Beach Erosion Board (U.S.A.)*, 1956.

#### NOBEL AWARD FOR CHEMISTRY—1956

THE Nobel Prize for Chemistry for 1956 has been awarded jointly to Sir Cyril Hinshelwood, President of the Royal Society, and Dr. Lee's Professor of Chemistry in the University of Oxford, and Professor Nikolas Semenov, Director of the Institute of Chemical Physics of the Soviet Academy of Sciences. The prize was awarded for their researches on the mechanism of chemical reactions.

Sir Cyril Hinshelwood has done pioneering work in the modern approach to chemical kinetics based on statistical mechanics and theory of absolute reaction rates—the study of rates at which chemical reactions proceed. The concept of molecules breaking into atoms which take part in successive reactions is largely due to Hinshelwood, and by this concept it is possible to explain the kinetics of many chemical reactions which otherwise would be incomprehensible. To cite a very simple example, Hinshelwood in his Bakerian lecture (1946) propounded the thesis that the reaction between hydrogen and oxygen molecules involve elementary steps with hydrogen atoms, and hydroxyl and perhydroxyl radicals as intermediates. Much of this work has become important not only in the rapid advances in the free radical and theoretical chemistry but also in its bearing on chemical industries. Hinshelwood has also exerted an enormous influence on chemical teaching as well as research in the Universities in his own country as well as outside through his profound writings such as "Kinetics of Chemical Change", "Structure of Physical Chemistry", etc. In recent years he has applied the methods of chemical kinetics to the metabolism of the bacterial cell and provided possible explanations of apparent adaptations.

Sir Cyril Hinshelwood has been a recipient of many honours from Chemical Societies in Europe as well as America and has been a member of the advisory council on scientific policy since 1953 in his own country. He is 59, unmarried and had his education in Westminster City School and Balliol College, Oxford. He was elected Fellow of the Royal Society in 1929 when he was thirty-two.

Professor N. Semenov, an outstanding figure among Soviet physicists and physical chemists, is famous for his investigations on the speeds of chemical reactions, chain and non-chain reactions, branching reactions, gas combustion, etc. The discovery of branched chemical chain reactions has helped a great deal in the development of a rational theory of the nature and mechanism of many complicated chain reactions involving hydrocarbons, oxygen, halogens, etc. Semenov's monumental work on "Chemical Kinetics and Chain Reactions" reveals not only the erudition of a scholar but the clarity and lucidity of exposition of a master, and this book has formed the basis of numerous investigations in oxidation, combustion, polymerization, etc. Professor Semenov has been the Head of the Institute of Chemical Physics of the U.S.S.R. Academy of Sciences for over a quarter of century.

That the Nobel Prize in Chemistry for 1956 has been awarded jointly to Hinshelwood and Semenov immediately after the award in 1954 to Staudinger implies a tribute not only to the brilliant achievements of the recipients but also no less to the kinetics of chemical reactions and the importance of chain reactions, both in the pure and applied fields.

M. SANTAPPA.



## NOBEL AWARD FOR PHYSICS—1956

THIS year's Nobel Prize for Physics has been awarded jointly to Drs. William Shockley, John Bardeen and Walter Brattain, members of the research staff of the Bell Telephone Laboratories, U.S.A., for their outstanding work on the electron physics of solids, especially semi-conductors, culminating in the recent development of the transistor, which is finding increasing application in electronics and communications.

Dr. Shockley, who is Director of Physics and Transistor Research in Bell Telephones, has made important contributions to our understanding of dislocations in relation to the plastic properties of metals, and has been responsible for the discovery of the transition to metallic characteristics in silicon and germanium on the addition of foreign atoms. He carried out several military assignments as expert consultant during the Second World War, and is the author of the book, "Electrons and Holes in Semiconductors". He was awarded the Leibmann Prize (1952), Buckley Prize (1953) and Comstock Prize (1954), in recognition of his distinguished work.

Dr. Bardeen has worked on the problem of diffusion in alloys, besides his collaboration in the development of the transistor. Before joining the Bell Telephone Laboratories in 1945, he was for some time a geophysicist in the Gulf Research and Development Corporation and served also in the U.S. Naval Ordnance Laboratory, Washington. Since 1951, he is professor of electronic engineering and physics, Illinois.

Dr. Brattain has studied the effects of charged particles on semiconducting materials in addition to the teamwork on transistor action. He was awarded the Ballentine Medal of the Franklin Institute in 1952.

The transistor was no accidental discovery, but actually one of the results of the intensive work on the physics of the solid state which has been vigorously studied for the past two decades. In addition to dislocations, which clarified our knowledge of the strength of metals and alloys, several other types of imperfections are now well recognised. Our present understanding of phenomena like luminescence, electrolytic conduction in crystals, photographic sensitivity, are only a few of the other results that have emerged from such a study. It is interesting to note that in the recent Bristol Conference (1954), the interest has shifted to irradiation effects in crystalline solids.

Since Dr. Shockley and his co-workers reported the thermionic valve-like characteristics of the transistor, several types have been perfected and it has come to stay as a standard component in electronic practice. The advantages of the transistor are small size, absence of a heater and possibility of operation with voltage and current of either polarity. The main drawbacks are appreciable interelectrode capacitance, limited power (less than a watt) and frequency (100 Kc/s.) ranges, which may be overcome by improved design. A fundamental obstacle to transistor development is the narrow tolerances in electrode spacings that require precision engineering. However, transistors are widely used nowadays in switching circuits of portable equipment, telephony and computers, where their compact size and limited power requirements offer special advantages in circuit design.

It is interesting to notice that the Nobel Laureates of this year are found in an industrial organisation. Perhaps it is a sign of the beneficial results of the participation of men of science in an enlightened industry.

K. S. CHANDRASEKHARAN.

## CATALOGUE OF NUCLEAR REACTORS

THE Chalk River Project of Atomic Energy of Canada, Ltd., with the co-operation of the Atomic Energy Research Establishment, Harwell, has prepared a "Catalogue of Nuclear Reactors, 1955" (AECL No. 220; CRR-590. Pp. 60. London: H.M.S.O., 1955; 4 sh. 6 d. net), which has been compiled from the unclassified literature and refers to reactors that are known to have reached criticality by July 1955. The catalogue includes reactors in Canada, France, Great Britain, Norway, Swe-

den, Switzerland, the United States and the U.S.S.R. The details given for each reactor consist of brief notes covering six items—neutron speed; fuel configuration; kind of moderator; purpose (research, power, etc.); thermal power; and neutron flux—as well as constructional details and one or two useful references. Additions to, and revisions of, the catalogue will be prepared from time to time in order to keep the collection of data up-to-date.

## LETTERS TO THE EDITOR

	PAGE		PAGE
<i>An Approximate Solution in Einstein's Field Theory of 1953</i> —RAMJI TIWARI ..	389	<i>Tetrazolium Reduction as an Index of Spoilage in Cured Fish</i> —S. V. SURYA-NARAYANA RAO, M. RAJENDRANATHAN NAYAR AND A. P. VALSAN ..	396
<i>A New Diffraction Method for Measuring Ultrasonic Velocities in Liquids</i> —M. RAMAKRISHNA RAJU AND B. RAMACHANDRA RAO ..	390	<i>Relation between the Nucleus and the Vacuole in Yeast</i> —(MISS) SARASWATHY ROYAN ..	397
<i>Equation of State of Zinc from Thermal Data</i> —S. SHIVANANDA TOLPADI AND C. R. PURUSHOTTAMAN ..	392	<i>Cytology of Ophioglossum</i> —S. C. VERMA	398
<i>Synthesis of 6-Hydroxy Flavonols by Algar Flynn Reaction</i> —L. RAMACHANDRA ROW AND C. SOMESWARA RAO ..	393	<i>Unusual Lesion in the Subcutis of a Fowl, due to the Fungus of Aspergillus Sp.</i> —R. M. KALAPESI AND B. L. PUROHIT	400
<i>Freezing Points of Adsorbate Liquids</i> —BALWANT RAI PURI, D. D. SINGH AND Y. P. MYER ..	394	<i>A New Technique for the Construction of Dykes in Deep-Silted Swamps</i> —G. N. MITRA ..	401
<i>Paper Chromatographic Technique to Detect Organic Acids in Citrus Plant Tissues (Citrus acid)</i> —T. N. SEKHARA VARMA AND C. V. RAMAKRISHNAN ..	395	<i>Embryo Sac Haustoria in Cassytha filiformis Linn.</i> —R. L. N. SASTRI ..	401
<i>Chemical Components of the Pods of Tephrosia purpurea var. maxima Baker</i> —N. V. SUBBA RAO ..	396	<i>The Spermatogonial Chromosomes of Riopa punctata (Gmelin)</i> —A. N. BHAT-NAGAR ..	402
		<i>Stability of Vitamin A in Vanaspathi</i> —S. S. PHATAK AND F. G. T. MENZES ..	403
		<i>The Development of Female Gametophyte in Biophytum sensitivum (L.) DC.</i> —D. A. GOVINDAPPA AND G. BORIAH ..	403

### AN APPROXIMATE SOLUTION IN EINSTEIN'S FIELD THEORY OF 1953

EINSTEIN'S generalized theory of gravitation<sup>1</sup> is based on field equations involving non-symmetric quantities and having the property of transposition invariance. In the notation of our earlier paper,<sup>2</sup> which is followed throughout this communication, the field equations of the theory are:

$$Q_{is}^s = 0$$

or its equivalent

$$(B^{is}\sqrt{|g|})_{,s} = 0, \quad (1)$$

$$Q_{kl,i} + Q_{li,k} + Q_{ik,l} = 0, \quad (2)$$

$$P_{kl} = 0. \quad (3)$$

Each of the two sets of the equations (1) and (2) consists of three independent equations. A brief report of some unpublished results is given here concerning the interaction between

the field of a uniform monochromatic radiation and a gravitational field of a point mass.

For the non-symmetric tensor  $g_{ik} = a_{ik} + b_{ik}$  we take

$$\left. \begin{aligned} a_{ii} &= - \left( 1 + \frac{2m}{r} + \frac{3}{2} \frac{m^2}{r^2} + \frac{m^3}{2r^3} \right) + h_{ii}, \\ i &= 1, 2, 3 \\ a_{44} &= 1 - \frac{2m}{r} + 2 \frac{m^2}{r^2} - \frac{3}{2} \frac{m^3}{r^3} + h_{44}, \\ a_{ij} &= h_{ij}, i \neq j \end{aligned} \right\} \quad (4)$$

$$\left. \begin{aligned} b_{12} &= \alpha, & b_{13} &= \phi + f, & b_{14} &= \gamma, \\ b_{23} &= \delta, & b_{24} &= \epsilon, & b_{34} &= \phi + \chi, \\ \phi &\equiv A \cos 2\pi (x - t)/\lambda. \end{aligned} \right\} \quad (5)$$

Here  $h_{ik}$  are the quantities of the third order of smallness.  $h_{ik}$  denote the correction terms to the gravitational potentials due to the presence of the electromagnetic field. Similarly

$\alpha$ ,  $\beta$ ,  $\gamma$ , etc., indicate a measure of the modification of the field of pure radiation due to the presence of the gravitational field. These are the quantities of the second order. Both  $m$  and  $\phi$  are the quantities of the first order of smallness.

We obtain from (1) and (2)

$$\begin{aligned}\alpha &= \epsilon = 2m\phi [x \log(x+r) - r]_{32}, \\ \beta &= \frac{4m}{r}\phi + 2m\phi_1 \log(x+r) \\ &\quad + 2m\phi [x \log(x+r) - r]_{33}, \\ \gamma &= -2m\phi [\log(x+r)]_{33}, \\ \delta &= 2m\phi [\log(x+r)]_{23}, \\ \chi &= \frac{2m}{r}\phi + 2m\phi_1 \log(x+r) \\ &\quad + 2m\phi [x \log(x+r) - r]_{33}. \quad (6)\end{aligned}$$

$\alpha$ ,  $\beta$ ,  $\gamma$ , etc., are associated with the electric and magnetic field strengths as shown below:

$$\begin{aligned}\alpha &= E_x, & \beta + \phi - \frac{2m}{r}\phi &= -E_y, & -\gamma &= H_x, \\ \delta &= E_x, & -\epsilon &= H_y, \\ & & -x - \phi - \frac{2m}{r}\phi &= H_z. \quad (7)\end{aligned}$$

The electric and magnetic field strength vectors are perpendicular to one another and upto the third order of approximations the two are equal to each other in absolute value. The electromagnetic field strengths and also the second and third components of the current vector density become infinite on the negative side of the  $x$ -axis.

When the values of  $\alpha$ ,  $\beta$ ,  $\gamma$ , etc., are substituted in (3), the field equations reduce to

$$R_{kl} = 0 \quad (8)$$

where

$$\begin{aligned}R_{kl} &= -\frac{1}{2}\delta^{\sigma\rho} \left( \frac{\partial^2 h_{kl}}{\partial x^\sigma \partial x^\rho} + \frac{\partial^2 h_{\sigma\rho}}{\partial x^k \partial x^l} - \frac{\partial^2 h_{k\sigma}}{\partial x^l \partial x^\rho} \right. \\ &\quad \left. - \frac{\partial^2 h_{l\rho}}{\partial x^k \partial x^\sigma} \right) \quad (9)\end{aligned}$$

with

$$\begin{aligned}\delta^{11} &= \delta^{22} = \delta^{33} = -\delta^{44} = -1, \\ \delta^{ij} &= 0, i \neq j. \quad (10)\end{aligned}$$

A particular solution of (3) has been obtained as

$$\begin{aligned}h_{11} &= 4m[\phi^2 \log(x+r)]_1, \\ h_{44} &= -4m[\phi^2 \log(x+r)]_4, \\ h_{22} &= h_{23} = h_{33} = 0, \\ h_{12} &= -h_{24} = 2m\phi^2 [\log(x+r)]_2, \\ h_{13} &= -h_{34} = 2m\phi^2 [\log(x+r)]_3, \\ h_{14} &= -2m[\phi^2 \log(x+r)]_1 \\ &\quad + 2m[\phi^2 \log(x+r)]_4. \quad (11)\end{aligned}$$

This solution contains a line of singularities. It is curious that the solution in the form of the well-known Schwarzschild solution through a singular transformation

$$x^a = x'^a + T^a$$

with

$$\begin{aligned}T' &= T^4 = 2\phi^2 m \log(x+r), \\ T^2 &= T^3 = 0.\end{aligned}$$

In the transition from general to the unified theory, the electromagnetic induce modifications in the gravitationals which are, however, found to be in line with the usual Schwarzschild solution through a singular transformation. The mathematical connection between the two solutions was unsuspected and is worthy of note.

I am indebted to Professor V. V. Narlikar for his guidance in preparing this note. Banaras Hindu University, RAM, October 27, 1956.

1. Einstein, A., *The Meaning of Relativity* (University Press), 1953. Pp. 133-6.
2. Narlikar, V. V. and Ramji Tiwari, *Inst. Sci. India*, 1949, 15, 249.

## A NEW DIFFRACTION METHOD FOR MEASURING ULTRASONIC VELOCITIES IN LIQUIDS

In this communication we present a new method of measuring ultrasonic velocities in liquids which is based on the diffraction of light induced by two identical superposed ultrasonic waves. The principle of the method is as follows: When two identical ultrasonic waves are set up side by side in a column of liquid with their wavefronts parallel, the diffraction pattern due to the light beam traversing the gratings parallel to the ultrasonic wavefront, shows variation in intensity as the phase difference between the two ultrasonic waves is continuously varied. Since the two ultrasonic waves have a path difference which is an integral multiple of the wavelength, the amplitude of corrugated emergent light wavefront is the sum of the amplitudes due to the individual waves and hence the diffraction pattern attains its maximum intensity. If, on the other hand, the path difference is an odd integral multiple of the wavelength, the compressions and rarefactions due to one ultrasonic wave lie on the same plane as the rarefactions and compressions due to the other so that the amplitude of the emerging light wavefront is zero. Hence due to the individual waves

the diffraction pattern acquires minimum intensity. It can now be easily seen that if one of the ultrasonic gratings is moved continuously along the direction of propagation, the intensity of the diffracted light reaches maxima or minima at regular intervals of one wavelength. Knowing the distance through which one of the gratings is moved to cover a fixed number of maxima or minima, the wavelength  $\lambda$  and hence the ultrasonic velocity  $V$  can be directly determined by using the relation

$$V = \nu \lambda$$

where  $\nu$  is the frequency of the ultrasonic waves.

The usual Debye-Sears progressive wave diffraction set up is employed for observing the diffraction patterns. Two identical circular X-cut quartz crystals of 1 in. diameter and 1.265 Mc/sec. fundamental frequency are connected in parallel across the output of a variable frequency Hartley oscillator for the purpose of generating two ultrasonic waves. The crystals were excited at about the third harmonic frequency as it is advantageous to use higher frequencies to set up progressive waves and to get more number of maxima. One of the crystals is mounted in a standard fixed crystal holder with the bottom surface in contact with the surface of the liquid in the ultrasonic cell. The other crystal is mounted in a movable crystal holder, shown in Fig. 1, which consists of two telescoping tubes, the inner tube C sliding freely inside the outer tube A which is rigidly fixed. The central leg of a spherometer which is rigidly fixed on A rests snugly in a small conical groove at the top of cylinder C which is held to it by two springs. An insulator ring T fixed to the bottom of cylinder C carries the crystal in a circular groove pressed to it by metal clips. These clips prevent the crystal from falling and serve as the bottom electrode terminals to the crystal. The groove surrounding the edge of the crystal is filled with paraffin to prevent the liquid in the tank from short-circuiting the crystal. The top surface of the crystal is insulated from the cylinder C by an insulated washer G. An insulated lead from the upper electrode E of the crystal is taken out for feeding power to the crystal. After making careful adjustments to ensure that the surfaces of the two crystals are parallel, the readings of the spherometer for every ten consecutive maxima are noted and the wavelength of the ultrasonic wave is evaluated. To attain very high accuracy in velocity measurements, a sensitive photomultiplier photometer has been used for judging the positions of maxima or minima.

With a view to check the accuracy and reliability of this method, velocity measurements were made for aqueous solutions of sodium chloride at various concentrations. The measured values for  $10\lambda$  and the calculated values of ultrasonic velocity  $V$  at various concentrations upto 1 molal are presented in Table I.

TABLE I  
Measurements at 32° C.

Molal concentrations	Frequency $\nu$ in Mc/sec.	$10\lambda$ cm.	Velocity m/sec.
0	3.864	0.3930	1519
0.2	3.810	0.4020	1531
0.4	3.857	0.4000	1543
0.6	3.829	0.4065	1556
0.8	3.828	0.4090	1566
1.0	3.822	0.4125	1576

The frequency of the oscillator which is found to vary from one concentration to the other due to probably the capacitance of the liquid in the ultrasonic tank, is measured by a precision Marconi Wavemeter. The value of ultrasonic velocity for water at 32° C. is in good

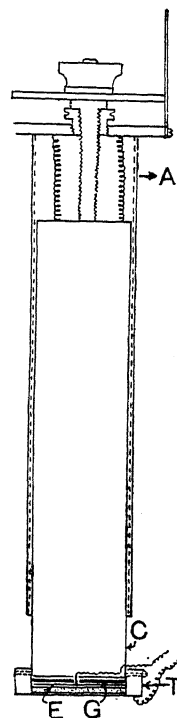


FIG. 1

agreement with the value reported by other workers. The variation of ultrasonic velocity with concentration is nearly linear being

57 m/sec. for 1 molal concentration. This value agrees well with the interpolated value of 57 m/sec. for 1 molal concentration obtained from the results of Barthel.<sup>1</sup>

The method is simple, accurate and reliable, but suffers from the disadvantage that it is applicable only for transparent liquids available in large quantities as the progressive wave tank must have a large capacity.

Ultrasonic Labs., M. RAMAKRISHNA RAJU.  
Physics Dept., B. RAMACHANDRA RAO.  
Andhra University,  
Waltair, October 28, 1956.

1. Barthel, R., *J. Acous. Soc. Amer.*, 1954, 26, 227.

### EQUATION OF STATE OF ZINC FROM THERMAL DATA

RECENTLY Dayal<sup>1,2</sup> has outlined a method of deriving the equation of state of solids directly from the observable data on thermal expansion, specific heat, and the elastic constants. Sharma<sup>3,4</sup> has followed the same lines in a study of the equation of state and the potential energy of cubic crystals. We have made suitable modifications in the methods adopted by these authors so that they can be applied to the hexagonal crystals. We start from the following equations of state given by Gruneisen,<sup>5</sup>

$$\left. \begin{aligned} X_x &= -\frac{\partial(\phi/V)}{\partial x_x} + \bar{\gamma}_{xx} \frac{E}{V} \\ Z_x &= -\frac{\partial(\phi/V)}{\partial z_x} + \bar{\gamma}_{zx} \frac{E}{V} \end{aligned} \right\} \quad (1)$$

Where  $X_x$  and  $Z_x$  are the components of stress and  $x_x$  and  $z_x$  those of strain,  $\phi$  is the potential and  $E$  the thermal energy.  $\bar{\gamma}_{xx}$  and  $\bar{\gamma}_{zx}$  are the average Gruneisen constants, namely,

$-\partial(\log \bar{v})/\partial x_x$ , etc. Gruneisen assumed that these are constants for all frequencies. In our method, the average constants alone appear and the question of their constancy is irrelevant for our purpose. They have been calculated from the following expressions taken from Gruneisen's work<sup>5</sup> with slight modifications:

$$\left. \begin{aligned} \alpha_x &= (S_{11} + S_{12}) \bar{\gamma}_{xx} C_v + S_{13} \bar{\gamma}_{xz} C_r \\ \alpha_z &= 2S_{13} \bar{\gamma}_{zx} C_v + S_{33} \bar{\gamma}_{zz} C_v \end{aligned} \right\} \quad (2)$$

where  $\alpha_x$  and  $\alpha_z$  are the coefficients of thermal expansion perpendicular and parallel to the hexagonal axis;  $S_{11}$ , etc., are the elastic moduli and  $C_v$  the specific heat at constant volume.

Starting from the equilibrium values of  $l_x$  and  $l_z$  at  $P = T = 0$  and using the thermal ex-

pansion data, values of lengths at various temperatures are calculated. These are the lengths measured at room pressures which is practically zero in the scales of pressures involved here. For these lengths, therefore, the stresses,  $X_x$ , etc., are zero and the first term on the right hand side of equation (1) is numerically equal and opposite in sign to the second term. This enables the first term in the right hand side of equation (1) to be calculated as a function of  $l$ . Pressures at various lengths, i.e.,  $X_x$ , etc., are then calculated from a knowledge of both the terms on the right hand side of equation (1). The procedure is the same, as in papers cited earlier, the only difference being in the use of two average Gruneisen constants, one parallel to the hexagonal axis and the other perpendicular to it. In the table, we have given the calculated values of

$$\frac{\Delta l}{l}, \text{ i.e., } \frac{l_{PT} - l_0}{l_0}$$

for zinc at various pressures by the present method, both perpendicular and parallel to the hexagonal axis. The thermal expansion data are taken from the observations made by Gruneisen and Goens;<sup>6</sup> the specific heat data from the work of Keesom and Ende<sup>7</sup> in the range 3.2° K to 20° K and Clausius and Harteck<sup>8</sup> in the range 21.9° K to 201.0° K; and the elastic moduli data from the measurements made by Bridgman.<sup>9</sup> The calculations have been made at a temperature of 303° K and the results have been compared with the experimental measurements of Bridgman<sup>10</sup> in Table I

TABLE I

	Pressure $p \times 10^{-7}$ dynes/cm. <sup>2</sup>	$\frac{\Delta l}{l} \times 10^4$ (Calculated)	$\frac{\Delta l}{l} \times 10^4$ (Bridgman)
Parallel to the hexagonal axis	168 369 571 742 918 1132	19 45 71 97 123 155	22 48 74 95 117 143
Perpendicular to the hexagonal axis	181 414 637 836 1026 1231	4 8 13 17 19 20	3.6 8 12 16 19 23

The agreement is found to be satisfactory within the limits of the accuracy of the experimental data.

The problem was suggested to us by Dr. B. Dayal and we are highly thankful to him for

his keen interest and valuable suggestions during the course of our work.

Physics Dept., S. SHIVANANDA TOLPADI.  
Banaras Hindu C. R. PURUSHOTTAMAN.

University,  
September 25, 1956.

1. Dayal, B., *J. Sci. Res., B.H.U.*, 1950-51, 1, 21.
2. —, *J. Chem. Phys.*, 1950, 18, 1302.
3. — and Sharma, K. S., *Proc. Phys. Soc.*, 1955, 48B, 1049.
4. Sharma, R. S., *Ph.D. Thesis*, 1954, Banaras Hindu University.
5. Gruneisen, E., *Handbuch der Physik*, Springer, Berlin, 1928, 10, 23-47.
6. — and Goens, *Ibid.*, 1928, 10, Table 16, 48.
7. Keesom and Ende, *Leiden Communications*, 1932, No. 219b.
8. Clausius and Harteck, *Z. Phys. Chemie*, 1928, 134, 256.
9. Bridgman, P. W., *Proc. Nat. Acad. Sci. Wash.*, 1924, 10, 411; *Proc. Amer. Acad. Arts Sci.*, 1925, 60, 306.
10. —, *The Physics of High Pressure*, G. Bell & Sons, Ltd., 1931, Table V, p. 160.

#### SYNTHESIS OF 6-HYDROXY FLAVONOLS BY ALGAR FLYNN REACTION

KOSTANECKI<sup>1</sup> was the first to synthesise 6-methoxy flavonols. Starting from 6-methoxy flavanone, the 3-isonitroso derivative was secured by the action of amyl nitrite and hydrochloric acid. Acid hydrolysis of the isonitroso derivative gave the flavonol in fair yields. In the course of our study on Algar-Flynn Reaction,<sup>3</sup> 6-hydroxy flavonols have been directly synthesised from chalcones and flavanones by the oxidation with hydrogen peroxide.

Vyas and Shah<sup>2</sup> condensed quinacetophenone (I,  $R' = H$ ) with benzaldehyde, anisaldehyde and vanillin in presence of alkali and reported the formation of chalcones only. This reaction is now repeated and it is noticed that the chalcones are invariably accompanied by the flavanones. These could be separated by virtue of their differences in solubilities in petroleum ether and acetone. Thus 2':5'-dihydroxy chalcone (II,  $R = R' = H$ ) and 2':5'-dihydroxy 4-methoxy chalcone (II,  $R = OCH_3$ ,  $R' = H$ ) and their corresponding flavanones were synthesised. The chalcones crystallised in the form of orange red prisms and gave reddish brown colour with alcoholic ferric chloride. The flavanones, however, were pale yellow crystalline compounds exhibiting no colour with ferric chloride. In conc. sulphuric acid, both chalcones and flavanones developed deep red colouration.

Oxidation of 2':5'-dihydroxy chalcone (II,  $R = R' = H$ ) with hydrogen peroxide in alkaline

solution proceeded smoothly and the 6-hydroxy flavonol (IV,  $R = R' = H$ ) could be secured in good yield (70-75%). Variations in the strength of alkali (2N and N/2) or in hydrogen peroxide (30% and 6%) or in time (2 hours being the minimum period) have no effect on the yield of the flavonol. A suitable procedure, therefore, consists in dissolving the chalcone in 2N alkali (NaOH) and adding 30% hydrogen peroxide slowly dropwise at the laboratory temperature. The original reddish orange solution quickly lost its colour, changing into pale yellow. After two hours, on acidification with dilute sulphuric acid, the flavonol separated out. Following the same procedure, 2':5'-dihydroxy-4-methoxy chalcone (II,  $R = OCH_3$ ,  $R' = H$ ) was converted into the corresponding 6-hydroxy-4'-methoxy flavonol (IV,  $R = OCH_3$ ,  $R' = H$ ).

The 6-hydroxy flavanones (III,  $R = R' = H$  and  $R = OCH_3$ ,  $R' = H$ ) were also similarly oxidised with hydrogen peroxide. The yield of the flavonols was as good as in the case of the chalcones. Indeed it has also been shown that the crude chalcone-flavanone mixture as obtained from the condensation of quinacetophenone with benzaldehyde and anisaldehyde, could be directly oxidised with advantage, to obtain 6-hydroxy flavonols. This method, therefore, can be usefully employed instead of that of Kostanecki.<sup>1</sup>

The identity of the 6-hydroxy flavonols (IV,  $R = R' = H$ , and  $R = OCH_3$ ,  $R' = H$ ) was settled by direct comparison of their methyl ethers with authentic samples. The flavonols and their methyl ethers gave bright green fluorescence in concentrated sulphuric acid.

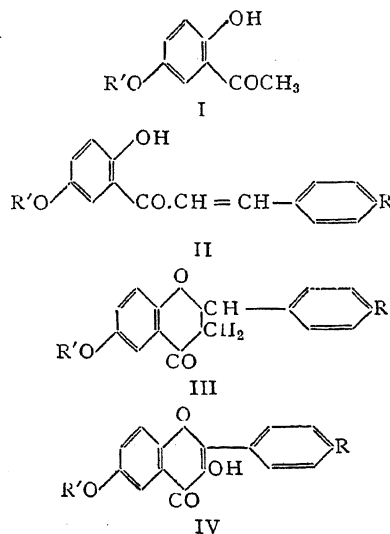


TABLE I

No.	Compound	m.p.	Formula	Calc.		Found	
				C	H	C	H
1	2' : 5'-dihydroxy chalkone	172-4°	C <sub>15</sub> H <sub>12</sub> O <sub>3</sub>	75.0	5.0	74.8	4.9
2	6-hydroxy flavanone	205-6°	C <sub>15</sub> H <sub>12</sub> O <sub>3</sub>	75.0	5.0	74.9	4.9
3	2' : 5'-dihydroxy-4-methoxy chalkone	142-3°	C <sub>16</sub> H <sub>14</sub> O <sub>4</sub>	71.1	5.2	71.3	5.3
4	6-hydroxy-4'-methoxy flavanone	178-80°	C <sub>16</sub> H <sub>14</sub> O <sub>4</sub>	71.1	5.2	71.0	5.3
5	3 : 6-dihydroxy flavone	232-3°	C <sub>15</sub> H <sub>10</sub> O <sub>4</sub>	70.8	3.9	70.7	4.0
6	3 : 6-dihydroxy-4'-methoxy flavone	273-4°	C <sub>16</sub> H <sub>12</sub> O <sub>5</sub>	67.6	4.2	67.5	4.4

6-Methoxy-flavanone (III, R = H, R' = CH<sub>3</sub>) was also similarly oxidised with 30% hydrogen peroxide in alcoholic alkaline medium. The 6-methoxy flavonol (IV, R = H, R' = CH<sub>3</sub>) was identical in all respects with that compound previously prepared by Kostanecki.<sup>1</sup> 6 : 4'-Dimethoxy-flavanone (III, R = OCH<sub>3</sub>, R' = CH<sub>3</sub>) could also be oxidised following this procedure to yield 6 : 4'-dimethoxy flavonol (IV, R = OCH<sub>3</sub>, R' = CH<sub>3</sub>). The yields in this method are better than in the Kostanecki's method.

In these oxidations, no benzal coumaranones could be discovered and the course of the reaction was normal in conformity with the conclusions of Geissmann and Fukushima.<sup>4</sup>

Dept. of Chemistry, L. RAMACHANDRA ROW.  
Andhra University, C. SOMESWARA RAO.  
Waltair, July 21, 1956.

1. Kostanecki, St. V. and Lampe, V., *Ber.*, 1904, 773, and 781.
2. Vyas, G. N. and Shah, N. M., *J. Ind. Chem. Soc.*, 1949, 26, 273.
3. Algar, J. and Flynn, J. P., *Proc. Irish Acad. Sci.*, 1934, 42 B, 1.
4. Geissmann, T. A. and Fukushima, D. K., *J. Amer. Chem. Soc.*, 1948, 70, 1686.

### FREEZING POINTS OF ADSORBATE LIQUIDS

SINCE capillary forces believed to be responsible for adsorption by porous bodies<sup>1,2</sup> influence vapour pressures at curved surfaces, it follows that freezing points of adsorbed liquids should be different from those in bulk. This affords a means to check the theory of capillary condensation. We have determined the freezing points of benzene, dioxane, *p*-xylene and ethylene diamine adsorbed on four different porous bodies at different relative pressures corresponding to condensation in capillary pores of different radii by measuring equilibrium pressures of the systems at different

temperatures and by plotting log *p* vs. 1/*T* curves. The freezing point depressions observed in the case of one of the liquids only are presented in Table I for illustration.

The perusal of the literature shows that while some workers<sup>4,5</sup> calculate theoretical freezing point depressions ( $\Delta T$ ) of capillary condensates on the assumption that the vapour pressure of the liquid in capillaries is lowered by surface tension effects but that of the solid is not, others<sup>3</sup> obtain the values on the assumption that the Kelvin equation is applicable to solids in capillaries as well, and that there is a corresponding lowering of the vapour pressure of the solid phase as well. The respective equations derived for the two different points of view may be represented as:

$$\Delta T = 2 T_0 \gamma' M / \rho r \Delta H \quad (1)$$

and

$$\Delta T = T / \Delta H \cdot 2M / r (\gamma / \rho - \gamma_s / \rho_s) T_0 \quad (2)$$

where *T*<sub>0</sub> is the normal and *T* the lowered melting point of the liquid condensed in capillary pores of radius *r*; *M* and  $\Delta H$  are its molecular weight and heat of fusion;  $\gamma$  and  $\gamma_s$  are its surface tensions and  $\rho$  and  $\rho_s$  are its densities in the liquid and solid states respectively, and  $\gamma'$  is the surface tension of the supercooled liquid at the lowered temperature *T*. The surface tension of the solid state can be calculated from the isotherms measured at two temperatures, one above and the other below the freezing point of the sorbate,<sup>3</sup> while that of the supercooled liquid is obtained by extrapolation.<sup>5</sup>

It is seen (Table I) that the observed values are in fairly close agreement with those calculated from Eq. (1) and at considerable variance with those calculated from Eq. (2). These results, therefore, do not support the postulates of Batchelor and Foster<sup>3</sup> but uphold the calculations of Puri *et al.*<sup>5</sup> and are fully in accord with the expectations of Carman.<sup>6</sup> It is also evident that the freezing point depression of

an adsorbate depends largely on the radius of the capillary pores in which it is condensed, irrespective of the nature of the adsorbent. This offers substantial support to the theory of capillary condensation.

A detailed account of the work will be published elsewhere.

TABLE I

Freezing point depressions of benzene held in various adsorbents at different relative vapour pressures

Capillary radius involved (Å)	Determined freezing point depressions ( $\Delta T$ ) in the case of:—				Theoretical $\Delta T$ from equation 1	Theoretical $\Delta T$ from equation 2
	Silica gel.	Ferric oxide gel.	Bentonite	Charcoal		
521	3.80	3.74	3.51	3.75	2.90	1.55
293	..	5.95	6.20	5.80	5.21	2.72
166	10.00	10.30	..	10.20	9.34	4.72
101	16.35	16.85	..	16.51	15.83	7.60
70.6	..	24.20	23.99	23.80	23.37	10.57
49.3	34.10	34.40	..	34.04	34.73	14.51
37.8	47.60	47.80	48.20	..	47.75	17.86
31.6	52.60	54.60	..	..	57.45	20.88

Dept. of Chemistry, BALWANT RAI PURI.  
Punjab University, D. D. SINGH.  
Hoshiarpur, August 22, 1956. Y. P. MYER.

1. Lambert, B. and Foster, A. G., *Proc. Roy. Soc.*, 1932, **136 A**, 363.
2. Pierce, C., Wiley, J. W. and Smith, R. N., *J. Phys. Colloid Chem.*, 1949, **53**, 689.
3. Batchelor, R. W. and Foster, A. G., *Trans. Faraday Soc.*, 1944, **40**, 300.
4. Higuitt, I. and Shimizu, M., *J. Phys. Chem.*, 1952, **56**, 198.
5. Puri, B. R., Sharma, L. R. and Lakhanpal, M. L., *Ibid.*, 1954, **58**, 289.
6. Carman, P. C., *Ibid.*, 1953, **57**, 56.

#### PAPER CHROMATOGRAPHIC TECHNIQUE TO DETECT ORGANIC ACIDS IN CITRUS PLANT TISSUES (CITRUS ACIDA)

DURING our investigations on the biosynthesis of citric acid in citrus fruits, it was found that none of the methods<sup>1-5</sup> described so far was found suitable for detecting organic acids in citrus tissue homogenates. Hence the method used by Martin and Steel<sup>6</sup> was slightly modified and used. The details of the modified method are reported here.

The parts of the citrus plant chosen for study were: (1) the fruit at two stages of its growth, (2) leaves, (3) stems, (4) root, and (5) flowers. The materials were brought fresh from a pri-

vate farm. A known weight of the material was immediately homogenised in a waring blender for 3-4 minutes with a minimum known quantity of water. The homogenate was then filtered through a funnel and the filtrate made up to a known volume. The filtrate was preserved under toluene in a refrigerator and used for the experiment.

Measured quantities of the extracts and a mixture of authentic samples of organic acids were spotted on a Whatman No. 1 filter-paper (24" × 24") and developed with the solvent recommended by Lugg *et al.*<sup>7</sup> (butanol:formic acid:water::5:1:4) at room temperature. The time of run was nearly 30 hours. The chromatogram was first air-dried and further dried in an oven at 70° C. for about 24 hours. It was then sprayed with the reagent of Reid and Lederer<sup>8</sup> and exposed to the vapours of ammonia. Clear and well-defined yellow spots without any tailing appeared on a violet background. The presence of different organic acids in the extracts was detected by comparing the  $R_f$  values with the  $R_f$  values of the acids in the standard synthetic mixture. The  $R_f$  values for the various acids are given in Table I along with the values obtained by other authors with different solvent systems. Table II shows the various organic acids detected in the extracts of tissues of different parts of the citrus plant.

TABLE I  
 $R_f$  values for the various organic acids

Acid		Present investigation	Solvent mixture		
			Kalyankar <sup>2</sup>	Bryant <sup>9</sup>	Cheftel <sup>10</sup>
Citric	..	0.47	0.37	0.31	0.23
Malic	..	0.53	0.44	0.39	0.32
$\alpha$ -keto-glutaric	..	0.67	..	0.63	0.63
Succinic	..	0.74	0.72	0.70	0.66
Aconitic	..	0.81	0.78	0.81	0.73
Fumaric	..	0.85	0.86	..	0.82

TABLE II  
Detection of organic acids in citrus plant tissues

Acid		Flowers	leaves	Stems	Roots	Fruits	
						(less than 1.5 cm. dia.)	Mature Fruits
Citric	..	+	+	+	+	-	+
Malic	..	-	+	+	+	-	+
Succinic	..	+	+	+	+	+	-
Fumaric	..	-	+	-	-	-	-

+ shows the presence of the acid, and - shows the absence of acid.



The authors' thanks are due to the authorities of the Baroda University for financing this project and for the award of a Research Assistantship to one of them (T. N. S.). Their thanks are also due to M/s. B. N. Patel & Sons for the generous supply of citrus plant.

T. N. SEKHARA VARMA.  
C. V. RAMAKRISHNAN.

Dept. of Biochemistry,  
M. S. University of Baroda,  
Baroda, September 3, 1956.

1. Govindarajan, V. S. and Sreenivasaya, M., *Curr. Sci. (Ind.)*, 1950, **19**, 269.
2. Kalyankar, G. D., Krishnaswamy, P. R. and Sreenivasaya, M., *Curr. Sci.*, 1952, **21**, 220.
3. Airan, J. W. and Barnabas, J., *J. Univ. Bom.*, 1953, **22**, 29.
4. Isherwood, F. A. and Hanes, C. S., *Biochem. J.*, 1953, **55**, 824.
5. Denison, Jr., F. W. and Phares, E. F., *Anal. Chem.*, 1952, **24**, 1628.
6. Martin, S. M. and Steel, R., *Can. J. Microbiol.*, 1955, **1**, 470.
7. Lugg, J. W. H. and Overell, B. T., *Aust. J. Sci. Res., Ser. A*, 1948, **1**, 98.
8. Reid, R. L. and Lederer, M., *Biochem. J.*, 1951, **50**, 60.
9. Bryant, F. and Overell, B. T., *Nature*, 1951, **168**, 167.
10. Cheftel, R. I., Munier, R. and Macheboeuf, M., *Bull. Soc. Chim. Biol.*, 1952, **34**, 380.

#### CHEMICAL COMPONENTS OF THE PODS OF *TEPHROSIA PURPUREA* VAR. *MAXIMA* BAKER

THE pods of *T. purpurea* var. *maxima* (*T. maxima* Pers.) collected at Waltair gave 7% ether extractives from which three crystalline components could be isolated. The first, which was designated as 'Purpuranin A', had a m.p. 189-91°, contained one methoxyl group and analysed for  $C_{21}H_{18}O_7$ . It neither gave a phenolic colouration nor did it respond to the test for rotenoids. It did not give any acetyl derivative but, however, underwent alkali degradation. The products of alkali degradation were a phenolic component, melting at 118-19° and a neutral one melting at 132-33°. The second crystalline substance, designated 'Purpuranin B', had a higher m.p. 224-25°, was less soluble in alcohol and had a tendency to form big crystals. It also contained one methoxyl but analysed for  $C_{23}H_{17}O_7$ . In other properties it resembled closely 'Purpuranin A' and gave on alkali degradation only a phenolic component melting at 142-43°. Both Purpuranin A and Purpuranin B did not possess toxicity to fish.

In contrast with the above two compounds the third compound designated 'Maximin', possessed toxic properties had a m.p. 143-45° contained one methoxyl group and analysed for  $C_{23}H_{22}O_6$ . The molecular formula aroused a suspicion that the compound might be impure rotenone but mixed m.p. with rotenone and the methoxyl value removed all doubts about its being impure rotenone. Although it resembled 'tephro-toxin' in containing one methoxyl, the molecular formula was considerably different. It contained further one methylene-dioxy grouping as indicated by the gallic acid test. The isolation of this toxic principle 'Maximin' from the pods was reported earlier by the author.<sup>1</sup> This substance like Purpuranins underwent degradation with alkali and gave a neutral component melting at 80°.

Recently Rangaswami and Sastry<sup>2</sup> reported the isolation of three crystalline components from the roots of *T. maxima* Aers, presumably Pers. Of the three components isolated by them only Maxima substance C appears to be identical with 'Maximin' obtained by us from the pods, whereas the rest seem to be different. It is quite likely that there would be a very close relationship between Purpuranins and Maxima substances A and B isolated by Rangaswami and Sastry (*loc. cit.*) as all these have been obtained from different parts of the same plant.

The work described here was done by the author in 1945 when he was at the Andhra University under the guidance of Prof. T. R. Seshadri and formed part of the thesis for the D.Sc. Degree of the University.

Dept. of Chemistry, N. V. SUBBA RAO.  
Osmania University,  
October 29, 1956.

1. Rao, N. V. S., *J.S.I.R.*, 1954, **13 A**, 31.
2. Rangaswami, S. and Sastry, B. V. R., *Curr. Sci.*, 1954, **23**, 397.

#### TETRAZOLIUM REDUCTION AS AN INDEX OF SPOILAGE IN CURED FISH\*

PREVIOUS attempts to employ redox indicators like methylene blue and resazurin for assessing the bacterial contamination of fish have been unsuccessful due to the presence of trimethylamine oxide which retards the lowering of redox-potential.<sup>1</sup> Since it has been suggested that more electropositive dyes may be useful, we have investigated the possibility of employing triphenyl tetrazolium bromide (T.T.B.)

\* Published with the kind permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam.

which has been often used in recent years for studying dehydrogenase systems.<sup>2</sup> Laxminarayana and Iya<sup>3</sup> have described a tetrazolium reduction test for milk. Though the Eo of T.T.B. is reported to be -80 mV, it is reduced by succinic dehydrogenase system having a much more positive normal redox-potential due to the insoluble nature of the reduced form.<sup>4</sup>

3 ml. to 5 ml. of fish muscle extract at pH 7.2 (1 part of muscle for 10 parts of phosphate buffer) made up to 6 ml. were incubated after adding 0.5 ml. of 0.5% T.T.B. Time taken for the onset of a distinct pink colour was noted and formazan formed after definite periods of incubation estimated by visual comparison after extracting with toluene.<sup>5</sup> Standards were prepared according to the method described by Fairbridge *et al.*<sup>6</sup>

Muscle from fresh samples of choodai (*Sardinella* sp.) did not show any reduction even after 18 hours. Among four different samples of sun-dried choodai, one specimen which was evidently spoiled and also showed a high T.V.N. value of 264 mg.% gave 360 µg. of reduced T.T.B. in 20 hr. as against 190 µg. to 220 µg. in other cases. In another experiment eight samples of sun-dried sardines from experimental lots and obtained from local curing centres and the local market were examined. Dye reduction was observed in 5 hr. to 8 hr. and samples cured in the laboratory showed no appreciable reduction. Maximum reduction amounting to 100% was observed with the market sample.

The influence of spoilage before curing was investigated by studying the dye reduction of cured samples of *Chirocentrus dorab* dry-salted after allowing to spoil at room temperature for different intervals. A distinct gradation was observed in the onset and extent of reduction in 4, 6, 8 and 12 hr. Values recorded during 6 hr. to 8 hr. were even more sensitive than Total Volatile Nitrogen in indicating the condition of the four different samples. Amount of dye reduced in 8 hr. ranged from 22.5 µg. to 41.3 µg.

During the course of this investigation we have examined about 20 samples of cured fish from Paramakudi market comprising of all the common varieties of fish. When the amount of dye reduced in 8 hr. was compared with the T.V.N. values, there appeared to be some relationship between the extent of reduction and the quality of the samples as revealed by T.V.N. values. Results of these preliminary experiments indicate that tetrazolium reduction may prove to be useful as a presumptive test for the detection of fish spoilage since

there exists a wide variation in the extent of reduction presumably related to the magnitude and nature of the bacterial population. Further work on these lines is in progress to evolve a suitable procedure by standardising the conditions.

While this work was in progress we have come across a brief report in the *World Fisheries Abstracts*<sup>7</sup> that similar work is in progress at Torry Research Station (U.K.).

We are deeply indebted to Dr. N. K. Panikkar, Chief Research Officer, for his keen interest and valuable suggestions.

Central Marine Fisheries Res. Station,  
Mandapam Camp,  
September 5, 1956.

S. V. SURYANARAYANA RAO.

M. RAJENDRANATHAN NAYAR.

A. P. VALSAN.

1. Castell, E. M., *J. Fish. Res. Bd. Can.*, 1956, **7**, 57.
2. Kun, E. and Abood, L. G., *Science*, 1949, **109**, 144.
3. Laxminarayana, H. and Iya, K. K., *Proc. Soc. Biol. Chem. (India)*, 1954, **12**, 56.
4. Jambor, B., *Nature*, 1954, **173**, 774.
5. Fahmy, A. R. and Walsh, E. O'F., *Biochem. J.*, 1952, **51**, 55.
6. Fairbridge, R. A., Willis, K. J. and Booth, R. G., *Ibid.*, 1951, **49**, 423.
7. Anon, *FAO World Fisheries Abstracts*, 1955, **6** (6), 2.

## RELATION BETWEEN THE NUCLEUS AND THE VACUOLE IN YEAST

In 1844 Nägeli<sup>1</sup> identified a body in living yeast as the homologue of the nucleus of higher organisms. It has been described under a variety of terms and its position in relation to the vacuole still remains unsettled.<sup>1-9</sup> Since the above descriptions are based on stained preparations it was thought desirable to clarify this problem from observations on living cells. Evidence was presented elsewhere<sup>10,11</sup> that the nucleus and the vacuole in living cells have membranes delimiting them from each other as well as the cytoplasm.

Fig. 1 is that of a living cell under phase contrast from a 120-hr. wort culture of a strain of *Saccharomyces cerevisiae*. The nucleus lies apposed to the vacuole and the distinct nuclear membrane (cf. Fig. 4, Wager<sup>1</sup>) encloses a formed structure inside. Without disturbing the sediment in the above culture, the spent wash was discarded and four times the original quantity of fresh wort was added to the tube. Phase contrast micrographs 2 and 3 are of a cell in two foci after stimulation for 90 minutes. The cytoplasm has encroached into the vacuolar space with the consequent

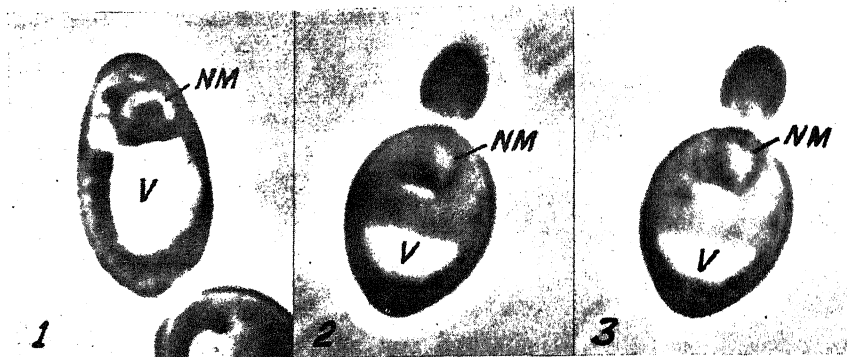


FIG. 1. Cell showing nucleus and vacuole. 120-hr. culture. (Phase contrast). FIGS. 2 and 3. A cell in two foci from a culture stimulated for 90 minutes with fresh wort (Phase contrast),  $\times 2,500$ .

N.M., Nuclear Membrane. V., Vacuole.

division of the vacuole into two unequal parts. There is also a reduction in the volume of the vacuole itself (Figs. 2, 3).

The presence of an intact nuclear membrane taken in conjunction with the encroachment of the cytoplasm into the original vacuolar space would confirm (i) the extra-vacuolar position of the nucleus, and (ii) the absence of any relation between the vacuole and the nucleus.<sup>1,2</sup>

The author is grateful to Dr. M. K. Subramaniam for his active interest and encouragement.

(MISS) SARASWATHY ROYAN.

Cytogenetics Laboratory,  
Indian Institute of Science,  
Bangalore-3, September 5, 1956.

#### CYTOLOGY OF *OPHIOGLOSSUM*

SINCE the publication of Manton's<sup>3</sup> work on the cytology of British species of *Ophioglossum*, the genus has received greater attention, and recently important work has appeared on the cytology of tropical ophioglossaceæ,<sup>5</sup> mostly from India. Detailed morphological and cytological observations have been made on three species of *Ophioglossum* by the author, the cytological part of which is presented here in summarized form, while a full report shall appear elsewhere. In all the three cases, studies were made from spore mother cells by the usual acetocarmine squash technique.<sup>3</sup>

*Ophioglossum polyphyllum* A. Br. apud Seubert<sup>6</sup> [*O. aitchisonii* (Clarke) d'Almeida<sup>2</sup> or *O. capense* Sw.<sup>1</sup>]: The present material collected at Hoshiarpur reveals 116 clear bivalents at the first meiotic metaphase (Fig. 1), (at the



FIG. 1. Metaphase of the first meiotic division in a spore mother cell of *Ophioglossum polyphyllum* A. Br. apud Seubert.  $n=116$ ,  $\times 825$ .

1. Wager, H., *Ann. Bot.* 1898, **12**, 499.
2. Janssens, F. A. and Leblanc, A., *Cellule*, 1898, **14**, 203.
3. Wager, H., and Peniston, A., *Ann. Bot.*, 1910, **24**, 45.
4. Guilliermond, A., *The Yeasts*, (John Wiley and Sons, New York), 1920; *The Cytoplasm of the Plant Cell*, (Chronica Botanica Co., Waltham, Mass.), 1941.
5. Lindegren, C. C., *The Yeast Cell, Its Genetics and Cytology*, (Educational Publishers, St. Louis U.S.A.), 1949.
6. — and Rafalko, M. M., *Expl. Cell. Res.*, 1950, **1**, 169.
7. Townsend, G. F. and Lindegren, C. C., *Cytologia*, 1953, **18**, 183.
8. Mundkur, B. D., *J. Bact.*, 1954, **63**, 514.
9. Lindegren, C. C., Williams, M. A. and McClary, D. O., *Antonie van Leeuwenhoek*, 1956, **22**, 1.
10. Royan, S., *Proc. Ind. Acad. Sci.*, 1956, **44 B**, 47 & 171.
11. — and Subramaniam, M. K., *Proc. Ind. Acad. Sci.*, **43 B**, 228.
12. Muller, R., *Naturwiss.*, 1956, **43**, 428.

most 117) and the chromosome number in *O. polyphyllum* is the least in the genus reported so far, being even lower than that of *O. costatum* R. Br.<sup>5</sup> ( $n=120$ ). The meiosis in *O. polyphyllum* is perfectly regular and seemingly normal and viable spores are produced.

*O. petiolatum* Hook.: On the basis of Chakravarty's<sup>1</sup> monograph on Indian *Ophioglossum*, this species is a new record for India. It was collected near Rajasansi Aerodrome (Amritsar) in March 1955 and 1956, growing on sandy banks of small rivulets. The identification was authenticated by Mr. F. Ballard (Kew) through the courtesy of Prof. R. E. Holttum. The species contains 510-515 bivalents and the course of meiosis is normal. The same chromosome number has also been reported for the Ceylon material.<sup>4</sup>

*O. vulgatum* L.: This cosmopolitan species has yielded most interesting results and for this reason it has been studied from three far off localities in India: Darjeeling, Mussoorie and Amritsar. In Darjeeling material there are clear 480 bivalents. The Mussoorie material yielded a count of 410-420 bivalents. Meiosis in both the cases is regular and morphologically the material from the two localities is uniform. In strong contrast to this there are at least two forms at Amritsar. The sterile leaf blade in one is acute and tapering and in the other it is obtuse and round. Cytologically the former has invariably a regular course of meiosis. In random collections from different localities round about Amritsar, different chromosome numbers: 340-346, 385-390, 410, 465-475 and 515-520 have been counted in dividing spore mother cells. This form exhibits a great variation in its size and there appears to be a definite correlation between the chromosome number and the size of the plants.

The form with obtuse apex is not the typical of the species as has been indicated by Mr. F. Ballard of Kew Botanical Gardens. Though the chromosome number very nearly falls within the same range as the form with acute apex yet cytologically it shows a highly abnormal course of meiosis. The observations were confirmed from a large number of specimens. Both univalents and multivalents have been observed, and their erratic behaviour both at Anaphase I and Anaphase II coupled with the abnormal cytokinesis results in the production of monads, diads (free or united), triads (Fig. 2a) tetrads (equal or unequal), pentads and hexads. At full maturity all the 'spores' become seemingly incapable of germination with thin cytoplasm and devoid of food mate-

rial. Apart from these, there are well-filled diplospores (Fig. 2b) formed by complete failure of the first meiotic division and a normal second division. If such spores are viable then the reproduction is apogamous. To the author's knowledge this is the first report of the occurrence of diplospory in Pteridophytes. It is also of interest to note that chromosome number for the species is much higher in the Indian flora than determined for the British material by Manton<sup>3</sup> ( $n \approx 256$ ).

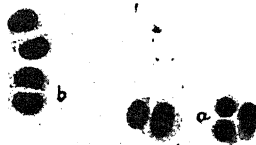


FIG. 2. Young abnormal spores of *O. vulgatum* (obtuse apex). (a) triads, (b) diplospores,  $\times 100$ .

Every effort to find gametophytes in nature proved to be futile and a critical examination based on two years of study shows that the reproduction is chiefly by vegetative means (root buds) in the entire *O. vulgatum* L. complex at Amritsar. Majority of the Darjeeling and Mussoorie specimens observed reproduce from root buds. It is not, therefore, surprising that the species is able to support the diverse chromosomal constitution on account of the efficient vegetative reproduction. Furthermore, these very factors could very well be the cause of polymorphy seen in the species.<sup>2</sup>

The author feels deeply indebted to Prof. P. N. Mehra for his helpful guidance and encouragement. Grateful thanks are also due to Mr. T. N. Khoshoo for criticism, to Prof. R. E. Holttum for help in the identification and to Mr. R. S. Pathania for the microphotographs illustrating the paper.

Dept. of Botany,  
Panjab University,  
Amritsar, July 12, 1956.

S. C. VERMA.

1. Chakravarty, H. L., *Bull. Bot. Soc.*, Bengal, 1951, 3, 1.
2. Claussen, R. T., *Mem. Torrey Bot. Club*, 1938, 19, No. 2.
3. Manton, I., *Problems of Cytology and Evolution in Pteridophyta*, 1950, Cambridge.
4. — and Sledge, W. A., *Phil. Trans. Roy. Soc., Lond.*, 1954, 238 B, 127.
5. Ninan, C. A., *Curr. Sci.*, 1956, 25, 161.
6. Pichi-Sermolii, R., *Webbia*, 1954, 9, 623.

# UNUSUAL LESION IN THE SUBCUTIS OF A FOWL, DUE TO THE FUNGUS OF *ASPERGILLUS* SP.

A FORMALIN fixed specimen from an Indian fowl was forwarded by the Veterinary Officer, Sirpur Veterinary Dispensary, to the Pathology Department of Bombay Veterinary College, for histopathological examination and report. The clinical history accompanying the specimen states that the bird with a hard lump on the ventral aspect of its abdomen, and of six months' duration was brought there for treatment. On examination and manipulation, it was noticed that the skin was torn and a hard lump was present in the subcutaneous region. This was easily removed by twisting. It is further reported that the bird has recovered after the removal of the lump which was suspected to be only a dry mass of fat.

The lump was found to be a spherical body measuring about 6 cm. in diameter and weighing 2 oz. On cutting through the specimen, it was seen to be made up of concentric laminations resembling those of an onion and having a necrotic centre (Fig. 1).



FIG. 1. Gross specimen showing distinctly the onion-like laminations and the necrotic centre.

Microscopic examination shows that the laminæ are made up of tissue which has de-

generated beyond identity and a network of fungus mycelia which are clearly noticeable on either surface of the laminæ. The space in between the laminæ is occupied by mycelia, and amongst them can be seen a number of mature conidiophores and free conidia, identical to those of *Aspergillus* species (Fig. 2). The



FIG. 2. Highly magnified view showing the mycelia and spores. One conidiophore with columella and sterigmata is distinctly seen.

particular species of the fungus involved, could not be determined as the specimen was sent fixed in formalin.

The finding of this peculiar lesion due to *Aspergillus* fungus, at an unusual site, is surprising. It would, therefore, be interesting to find out if such a lesion is common, whether this has any relation with the abdominal airsacs which are sometimes involved in *Aspergillus* infections, and the particular species of the *Aspergillus* fungus involved in such lesions.

Bombay Veterinary College. R. M. KALAPESI.  
Parel, Bombay-12, B. L. PUROHIT.  
July 30, 1956.

1. Schlegel, M., Cited by Bullis, K. L., *Disease of Poultry*, by H. E. Biester and Louis Devries, The Iowa State College Press, 1945.

### A NEW TECHNIQUE FOR THE CONSTRUCTION OF DYKES IN DEEP-SILTED SWAMPS

THERE are extensive swamps in many States of India, which are at present lying derelict. Reclamation of such swamps into fish ponds has been recognised as an effective means of making them productive (Wilson,<sup>1</sup> Schuster *et al.*<sup>2</sup>). Since 1949 a scheme for the reclamation of swamps has been in progress in the State of Orissa and upto now over 30 swamps have been converted into productive fish farms. The author has in a recent article<sup>3</sup> described the methods adopted for swamp reclamation in Orissa, which mainly consist of eradication of weeds, dewatering, construction of dykes and their turfing and provision of sluices. Experience so far gained in the culture of fish in reclaimed swamps has shown that it is more profitable to construct fish ponds in deep-silted swamps which are very productive. But the construction of dykes in such swamps has presented great difficulties and it has been found impossible to complete the central dykes in them even when the silt is allowed to settle for one year before piling of silt next year.

For the construction of dykes, generally the swamp is dewatered by draining or by means of power pumps and the surface of the swamp bed is dried to a depth of 9" to 12". Earthwork is then done by manual labour and silt is piled up on the dyke. But a slushy mass remains below the crust and the pile of silt after attaining a certain height spreads out and the dyke flattens itself. Any further piling of silt does not raise the dyke but causes greater flattening, even when pile driving is resorted to.

During this year a new technique was tried for the reclamation of Kiakani swamp in Orissa (36 acres in area) which had a silt deposit of 8 ft. to 12 ft. This technique which is described below was found very successful and it was possible to complete the reclamation work of this swamp in one working season extending from February to June.

In the new technique, a silt retaining wall with good cohesive resistance is formed by subsoil pumping instead of pumping on the surface. The water-level is maintained at about 4 ft. to 5 ft. below the crust by round the clock pumping and then the silt forms a solid mass. Being impervious, this mass does not allow seepage of water from the bottom, provided pumping is constantly done to maintain the subsoil water-level. This second crust serves as a berm to hold the silt in position and as more and more silt is piled up and the load in-

creases in the centre, the downward thrust of the silt clods is counteracted and the surface of the retaining wall on both sides raises itself to convex slopes. The upward thrust is indicated clearly by typical fissures of the clods which are wider on the surface and narrower below. The self-raising berm is caused by the upward thrust of the second component, while the first one keeps the piled up silt in position. Centrally piled up silt together with the convex ledge of the berm can then be aligned to make a perfect and permanent embankment. In Kiakani, subsoil pumping was done to a depth of 5 ft. and drains running from several points of the swamps were excavated to the pumping pit. Dykes were made 120 ft. wide at the base but the silt was piled only on about 20 ft. at the centre, the rest forming the self-raising berm. The dykes which were 12 ft. to 15 ft. in height became quite stable by this method and it withstood very well this year's unusually heavy rains in the area.

The new technique of constructing dykes does not involve any additional expenditure, but has the great advantage that the work can be completed in one season and the dykes thus constructed are permanent and strong. This technique is now being followed for the reclamation of several swamps in the State, with very encouraging results and it is likely that this method can be adopted with advantage in similar work conducted in other areas in the country.

Dept. of Fisheries,  
Cuttack, August 22, 1956.

G. N. MITRA.

1. Wilson, H. C., *Madras Fish. Bull.*, 1917, **11**, 161.
2. Schuster, W. H., Kestenen, G. L. and Colling, G. E. P., *F.A.O. Fisheries Study*, 1954, No. 3.
3. Mitra, G. N., *Progress of Fisheries Development in India*. Published by the Executive Committee, All-India Fisheries Exhibition, 1956, 54-61.

### EMBRYO SAC HAUSTORIA IN CASSYTHA FILIFORMIS LINN.

THE only available information on the embryology of the parasitic twiner *Cassytha filiformis* is contained in some casual observations of Mirande<sup>1</sup> on the structure of the ovule, fruit and seed. An embryological study of the species by the author revealed an overwhelming similarity with other members of Lauraceae in respect of structure and development of anther, pollen, carpel, ovule, fruit and seed. However, the behaviour of the female gametophyte proved to be unique for Lauraceae and is briefly described in this communication.

Of the numerous archesporial cells in the ovule, the hypodermal ones cut off primary parietal cells while the deep-seated ones function directly as megaspore mother cells, almost all of which later undergo meiotic divisions and form linear tetrads of megaspores. A large number of megaspores, usually the lowest one in each tetrad, begin developing into embryo sacs of which upto six reach maturity and the others degenerate at various stages. At the two nucleate stage, some of the embryo sacs begin to elongate like haustorial tubular processes in the direction of the micropyle, crushing the intervening cells of the nucellus, and eventually about one to four of them succeed in protruding beyond the nucellus and enter the over-arching funiculus which lies in close contact with the nucellus in the micropylar region (Fig. 1). Meanwhile, cells of the funiculus break down in the region just below the style resulting in the formation of a more or less wide canal which extends into the interior, breaking its way through the vascular strand (Fig. 1). One or two mature embryo sacs lie

Santalaceae<sup>3</sup> in which the embryo sacs might even travel far into the style.

The author's thanks are due to Professor J. Venkateswarlu for his guidance.

Dept. of Botany, R. L. N. SASTRI.  
Andhra University, Waltair,  
September 12, 1956.

1. Mirande, K., *Ann. Sci. nat. (Bot.)*, 1905, **2**, 181.
2. Maheshwari, P., *An Introduction to the Embryology of Angiosperms*, McGraw-Hill Co., New York, 1950.
3. Paliwal, R. L., *Phytomorphology*, 1953, **4**, 173.

### THE SPERMATOGONIAL CHROMOSOMES OF *RIOPA PUNCTATA* (GMELIN)

THE spermatogonial chromosomes of *Riopa punctata* consist of 24 elements which, as usual in reptiles, fall into two distinct categories, i.e., macro- and micro-chromosomes (Fig. 1). The macro-chromosomes, 12 in num-

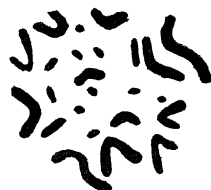


FIG. 1. Polar view of Spermatogonial Metaphase,  $\times 4,000$  (approx.).

ber, lie on the periphery of the equatorial plate and are V- or J-shaped, possessing, median and submedian spindle fibre attachment, respectively. The micro-chromosomes lie scattered in the centre of the spindle and are surrounded by the macro-chromosomes. The 12 micro-chromosomes comprise two small rod-shaped and ten dot-shaped elements, and all of them possess terminal spindle fibre attachment. The chromosome complement of the male karyotype of *Riopa punctata* is:

$$12 \text{ V's} + 2 \text{ R's} + 10 \text{ D's} = 24$$

This karyotype nearly resembles the fourth type of karyotype, described by Makino and Momma<sup>1</sup> for *Eumeces latiscutatus*, in the family Scincidae. The karyotype of *Riopa punctata*, however, differs from that of *Eumeces latiscutatus* in that it wants two rod-shaped micro-chromosomes. *Riopa punctata* possesses the smallest number of chromosomes ever reported from the family Scincidae.

Matthey's 'complexe scinco-lacertoide', the formula for the members of the families Lacertidae and Scincidae, is not accepted by Nakamura<sup>2</sup> or by Makino and Momma.<sup>1</sup> But so far as the karyotype of *Riopa punctata* is con-

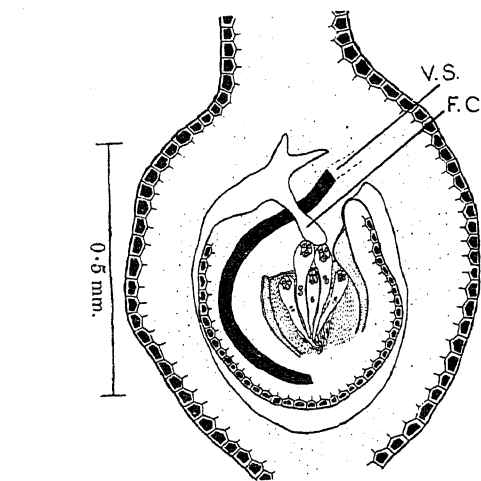


FIG. 1. L.S. gynoeceum showing single anatropous, pendulous, bitegmic ovule with 5 embryo sacs of which two are protruding out of the nucellus and abutting on the funicular canal. (F.C.—Funicular canal; V.S.—Vascular strand; partly reconstructed from serial sections.)

directly abutting on this canal and one of them is usually fertilised while all others degenerate. The organization of the embryo sac shows no unusual features.

Such haustorial elongation of the embryo sac has been met with in several species of angiosperms of diverse families (vide Maheshwari<sup>2</sup>) but it is significant that some of the most conspicuous instances are found in members of parasitic families like Loranthaceae<sup>2</sup> and

cerned, it seems to fit in the 'complexe scinco-lacertoide', formulated by Matthey.<sup>3</sup>

My thanks are due to Prof. M. D. L. Srivastava for taking keen interest and guiding the above work.

Dept. of Zoology, A. N. BHATNAGAR.  
University of Allahabad,  
Allahabad, September 22, 1956.

1. Makino, S. and Momma, E., *Cytologia*, Tokyo, 1949, 15, 96.
2. Nakamura, K., *Ibid.*, 1931, 2, 385.
3. Matthey, R., *Rev. Suisse Zool.*, 1931, 38, 117.

### STABILITY OF VITAMIN A IN VANASPATI

UNDER the rules<sup>1</sup> currently in force, all Vanaspati manufactured in the country is required to contain a minimum of 700 International Units of Vitamin A per ounce; synthetic vitamin A in the form of acetate or palmitate is being used for this purpose. Necessary precautions are being taken by the factories to ensure that their product contains the specified quantity of vitamin A at the time of manufacture. However, as vitamin A, whether natural or synthetic, is somewhat prone to oxidative deterioration on prolonged storage, it was thought useful to ascertain how far the initial vitamin A potency of 700 I.U./oz. is retained by Vanaspati after storage over a period of 6 months, in sealed containers at room temperature.

To this end, six samples of Vanaspati were drawn from different factories, each of which was divided at source into eight 4 oz. portions which were packed in sealed containers. The six sets of samples were stored at room temperature (20-37° C.) over a period of 24 weeks. One sample from each set was examined at intervals of 4 weeks. The vitamin A content was determined by the conventional Carr-Price method after chromatographic separation of the vitamin on alumina.

The results obtained are shown in Table I.

TABLE I  
Vitamin A content (I.U./oz.) of Vanaspati  
stored upto 24 weeks

No. of sample	Initial	Period of storage (weeks)						% loss after 24 weeks
		4	8	12	16	20	24	
1	703	662	638	613	594	575	561	20.2
2	715	674	638	614	594	584	542	24.2
3	703	650	625	610	588	568	552	21.5
4	674	640	607	584	553	548	535	20.6
5	683	650	594	574	560	542	528	22.7
6	715	672	625	614	603	561	539	24.6

It is seen from Table I that the storage loss of vitamin A in Vanaspati, fortified at a level of 700 International Units per ounce, over a period of 6 months is of the order of 20-25%.

Directorate of Sugar and S. S. PHATAK.

Vanaspati, Govt. of India, F. G. T. MENZES.  
New Delhi, September 14, 1956.

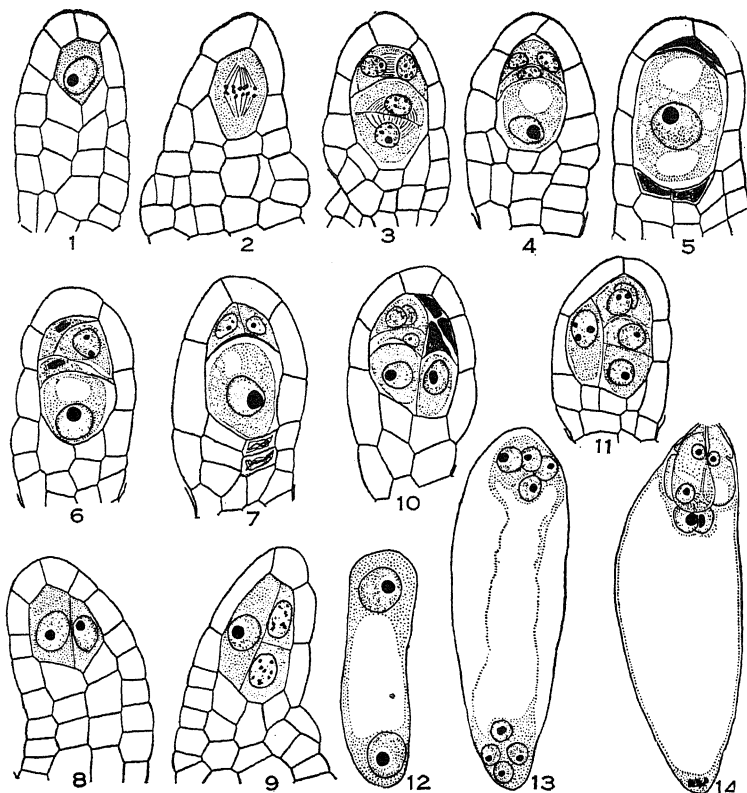
1. Government of India, Ministry of Agriculture Notification No. S.R.O. 78 0, dated the 21st October 1950 (as amended).

### THE DEVELOPMENT OF FEMALE GAMETOPHYTE IN *BIOPHYTUM* *SENSITIVUM* (L.) DC.

MAURITZON<sup>1</sup> in his embryological studies of Gruinales stated without the support of drawings, that the development of the female gametophyte in *Biophytum sensitivum* conforms to the Normal type. Thathachar<sup>2</sup> investigated the same species and reported an Allium type of embryo sac development in his paper on Oxalidaceæ. According to him the megaspore mother cell after the meiotic division results in the organisation of a dyad. The micropylar dyad cell divides vertically giving rise to two juxtaposed megaspores while the chalazal one directly develops into an 8-nucleate embryo sac of the Allium type. Recently while reviewing the bisporic embryo sacs Maheshwari<sup>3</sup> admitted with reservation the occurrence of a bisporic female gametophyte in the Oxalidaceæ. A re-investigation was, therefore, undertaken at the kind suggestion of Thathachar and the observations are presented in this note.

A hypodermal archesporial cell differentiates early in the ovular primordium (Fig. 1) and directly functions as the megaspore mother cell. After the first nuclear division during meiosis it gives rise to the dyad (Figs. 2-3). The micropylar dyad cell divides vertically while the chalazal one undergoes a transverse division resulting in a T-shaped tetrad of megaspores (Figs. 3-7, 10-11). Frequently a vertical wall is not laid down in the upper dyad cell (Figs. 3-4). The three micropylar megaspores degenerate and the chalazal one functions in the development of the embryo sac (Fig. 5). In one case two megaspores in a tetrad showed signs of further development (Fig. 6). Often there is a very early degeneration of the upper megaspore derived from the chalazal dyad cell (Fig. 7). Such stages might have possibly led Thathachar to conclude the development of embryo sac to be bisporic.





FIGS. 1-14. Fig. 1. L.s. ovular primordium with hypodermal archesporium. Fig. 2. First division of megaspore mother cell. Fig. 3. Nuclear division in the dyad cells. Fig. 4. T-shaped tetrad of megaspores. Fig. 5. Shows the functional megaspore with the three upper degenerated megaspores. Fig. 6. Two megaspores in a tetrad showing signs of further development. Fig. 7. Early degeneration of the upper megaspore derived from the chalazal dyad cell. Fig. 8. Double archesporial cells in the same ovular primordium. Fig. 9. A dyad beside a megaspore mother cell. Fig. 10. Double tetrads of megaspores. Fig. 11. T-shaped tetrad of megaspores. Figs. 12-13. Stages in the development of the female gametophyte. Fig. 14. A mature embryo sac. Figs. 1-13,  $\times 485$ . Fig. 14,  $\times 323$ .

Occasionally double archesporial cells have been observed in the same nucellus. Both may develop further into tetrads of megaspores or one of them may lag behind (Figs. 8-11).

The functional megaspore enlarges and becomes vacuolate (Fig. 5). Its nucleus divides and the two daughter nuclei are pushed apart to opposite poles by the formation of a central vacuole (Fig. 12). After two more nuclear divisions the 2-nucleate embryo sac develops into an 8-nucleate embryo sac (Figs. 12-14). A fully organised female gametophyte remains in contact with the inner integument. The egg apparatus consists of two synergids with an indentation and an egg. The polar nuclei lie together near the egg. The antipodals are ephemeral (Fig. 14). The development of the

female gametophyte, therefore, conforms to the Polygonum type.

We are highly thankful to Professor K. N. Narayan for his constant encouragement and interest during the course of this investigation and to Mr. Thathachar for suggesting the problem. Thanks are also due to Mr. M. V. S. Raju for having collected the material for us.

Dept. of Botany,  
Central College,

D. A. GOVINDAPPA.  
G. BORIAH.

Bangalore-1, October 24, 1956.

1. Mauritson, J., *Svensk Botanisk Tidskrift*, 1934, 28, 84.
2. Thathachar, T., *J. Indian Bot. Soc.*, 1942, 21, 21.
3. Maheshwari, S. C., *Phytomorphology*, 1955, 5, 67.

## REVIEWS

**The Mechanical Testing and Inspection of Engineering Materials.** A Monograph by Dr. J. H. Lamble. (Cleaver-Hume Press Ltd., London), 1956. Pp. 460-98. Price 3 sh. 6 d.

In about 39 pages, Dr. Lamble has covered the fundamentals of testing, as can be carried out in a Strength of Materials Laboratory of a Technical College. The scope includes mechanical testing for production control as well as tests for obtaining design data.

The monograph forms a chapter of a larger work on Workshop Technology, and has been reprinted for the use of those interested only in mechanical testing especially on a laboratory scale.

After briefly touching on the type of testing machines, their accuracy and scope, the author gives data for preparation of standard specimens based on the British Standards Specifications. He covers the usual tensile, bending, impact, torsion and hardness tests especially with reference to ferrous samples. Fatigue tests also have been discussed as well as tests on creep at elevated temperatures. Photoelastic tests and modern strain gauges have not however been included in this short monograph.

There is a useful bibliography, and references given at the end of the monograph are bound to be useful for those requiring more information on the subject.

V. S. JAYARAMAN.

**Acridines.** By R. M. Acheson, with a chapter by L. E. Orgel. (Interscience Pub.), 1956. Pp. 409. Price \$12.5.

This volume dealing with acridines is the ninth of the series of monographs on the chemistry of heterocyclic compounds edited by Weissberger. It begins with a useful discussion of the present confusing position regarding the numbering of acridine. The arguments of Albert (*The Acridines*, 1951) in favour of the Richter system are refuted, and the Graebe system, used in Beilstein and in *Chemical Abstracts* after 1937, is adopted. The first three chapters give a detailed account of the methods of preparation and properties of acridines and acridones, special attention being paid to the aminoacridines in view of their antibacterial and antimalarial properties. Albert's book

deals in greater detail with physical and biological properties, but the present volume gives a fuller and better account of the chemistry of the acridines. There is, for instance, an excellent chapter on the acridine alkaloids, which only receive a passing mention in Albert's book.

Acridinium salts, reduced acridines, and biacridines are fully covered in two chapters. Dr. Orgel contributes a short chapter on the visible and ultraviolet absorption spectra of acridine and its derivatives. Benzacridines and more complex condensed acridines are surveyed in a chapter, which also unaccountably includes acridine dyes. The old and simple acridine dyes as well as the acridone vat dyes are discussed with references to the relevant literature. Indanthrene Yellow R and Blue 8 GK are obsolete; the constitution given for the latter is erroneous. Indanthrene Pink BL and BBL should read as Brilliant Pink BL and BBL.

Weissberger's series on heterocyclic compounds is a necessary addition to a chemical library, and the present volume is particularly valuable.

K. V.

**Currents in Biochemical Research.** By David E. Green. (Interscience Publishers, New York), 1956. Pp. xvi + 697. Price \$10.00.

Ten years ago Dr. Green published "Currents in Biochemical Research", after the remarkable success achieved by his earlier publication in 1937 of 'Perspectives in Biochemistry', a book, which was dedicated to the late F. G. Hopkins on his 75th birthday. The cordial reception given to these earlier publications by biologists, chemists, biochemists and clinicians coupled with the fact that tremendous advances had been made during the last decade in various fields of biochemical research has encouraged him to edit the present volume under review. A distinguished group of twenty-seven contributors drawn from United States as well as from other countries has contributed these essays and they have been so well written as to give the "non-specialists an overall impression of the present status of the significant problems in each field, to point up the broad strategy of current research and finally to speculate on the likely paths of research". Among the subjects dealt with may be mentioned the following: chemistry and viral growth, photosynthesis,

bacterial fermentations, hormones, problems of cellular biochemistry, enzyme complexes, hæmoprotein reactions, protein structure, nucleic acids, porphyrins, interconversion of sugars and an integrated concept of carcinogenesis.

H. A. Barker in his article on bacterial fermentations has dealt with various fermentation patterns and has described how research in recent years on this subject has shifted to the analysis of the chemical mechanisms of fermentations since anaerobic bacteria provide relatively simple and convenient systems for the study of metabolic processes. E. E. Snell has considered some aspects of vitamin and growth factor research including that of his own on vitamins of the B<sub>6</sub> group, folic and folinic acids, pantetheine, biocytin, vitamin B<sub>12</sub> and lipoic acid. Spigelman and Campbell in their article on induced enzyme formation have described various experiments which strongly implicate ribonucleic acid as the template in the process of enzyme synthesis, while Gregory Pincus in his article on the hormones has outlined those areas of hormone research where the available information is scanty and where research workers can reap a rich harvest by intensive investigations. C. F. Cori, the Nobel-Laureate, has written on problems of cellular biochemistry, while Fritz Lipmann, another Nobel-Laureate, has posed certain basic biochemical questions and has indicated the probable directions in which the answers can be found by future investigators. H. R. Mahler, in his article on enzyme complexes and complex enzymes, has given a very lucid account of the work on various metallo-flavoproteins, hæmoflavoproteins and the electron transferring flavoprotein. This is followed by quite a number of excellent articles on enzymes, such as enzymes as reagents by E. Racker, relation between prosthetic groups, coenzymes and enzymes by H. Theorell, enzyme substrate compounds and electron transfer by Britton Chance and enzyme kinetics by R. A. Alberty. So also in the field of proteins and nucleic acids there are a good number of fascinating articles contributed by such noted authorities as J. T. Edsall, F. Sanger, W. E. Cohn and F. M. Huennekens, while special articles relating to blood by D. M. Surgenor, nerve activity by D. Nachmansohn and I. B. Wilson and carcinogenesis by H. P. Rusch belong to a different category altogether and deserve careful reading.

On the whole, the Editor has done exceedingly well in compiling these twenty-seven well written essays, representing the main currents in biochemical research. He has, however, in

all modestly denied himself the privilege of contributing an article from his own pen and has confined himself to only a few remarks in the preface. Dr. Green's contributions during the last decade constitute one of the main currents of biochemical research if not the most important of them all, and everyone would have relished reading his authoritative account of the same. Even so, the volume will be found to be an extremely valuable possession by one and all interested in biochemical teaching or research in the various fields of scientific endeavour.

P. S. SARMA.

Coimbatore Canes in Cultivation. Second Edition. By N. L. Dutt and J. T. Rao. (Indian Central Sugarcane Committee), 1956. Pp. 126. Price Rs. 25.

The second revised and enlarged edition under review will no doubt serve a useful purpose by providing readers an up-to-date treatise on the subject. Of particular importance is the inclusion of chromosome numbers and epidermal patterns of stem as also two keys for varietal identification—one based on stem epidermal patterns and the other on morphological character. While these have greatly enhanced the value of the publication for both laboratory and field workers, certain inaccuracies have unfortunately crept in, e.g., the discrepancy in colour of B.O.21 as stated in the key (p. 12) and depicted in Plate XVIII, references to *gur* areas of North Bihar (p. 56), which have hardly any existence and resistance of Co.453 (p. 64) and B.O.11 (p. 97) to red rot. Certain vague statements are also made, such as resistance of Co.244 (p. 31) to insects without reference to the species involved, when quite a few are known to be major pests of sugarcane. Some important emissions are similarly noticeable, there being no mention of the high susceptibility of Co.513 to Smut (p. 72). Varieties occupying large areas of 1 to 2 lakh acres do not find a place in the map appended. Needless repetition of the same matter while describing parentage of several varieties could also have been avoided with advantage. Similarly, in the absence of information regarding the number of root eyes in the two sets of standards used (Co.205, Co.213, *Hemja* and *Chunnee* on the one hand and E.K.28, 247B, POJ2878, Purple Mauritius and *Pundia* on the other), the reader fails to get any idea of the same in case of the different varieties described. Outmoded nomenclature in respect of certain parts of the sugarcane plant, such as 'Joint', 'ligular process' and

'transverse mark', equivalent respectively to 'internode', 'auricle' and 'dewlap', could likewise have been avoided. In fact, the simultaneous use of the two sets of terms is, at times, apt to be confusing. The book would have gained in value if a list of Coimbatore canes along with their immediate parentage and years of release were appended.

The publication, on the whole, is informative and fills a real gap, providing as it does all available details with regard to morphology and agricultural performance of important commercial canes. The get-up and printing are excellent which no doubt account for the rather high price of the book.

K. L. KHANNA.

**The Disposal of Sewage. Third Edition, Revised.**

By T. H. P. Veal. (Chapman & Hall, London), 1956. Pp. 208. Price 30 sh. net.

The first edition of this book was published in 1927 with the object, as stated in the preface, of presenting "the subject in a manner suitable for students or those who wish to acquire the main principles without unnecessary detail". During the last three decades considerable developments have taken place in the field of sewage treatment, and the book has also been accordingly revised, but it remains designed essentially for those desirous of acquiring a knowledge of the principles and practice of sewage disposal. Considering the very large volume of literature on the subject, the author has done very well indeed to produce a small, readable volume which will be found most useful by students, sanitary inspectors and engineers.

In the eleven chapters of this book, the following aspects are successively dealt with: introductory and historical; quantity of sewage; analyses of sewage and their meaning; preliminary processes; settlement processes; bacteria beds; bio-aeration tanks; disposal of sludge; treatment of trade waste (which is a new chapter in this edition); lay-out and construction of sewage disposal works; and sewage disposal in rural districts. There is an appendix on the sewage disposal scheme for a town of 50,000 inhabitants. The illustrations (73) included are most helpful. Throughout this account, which is lucid and concise, very valuable information particularly of practical interest is given. The sewage disposal schemes proposed for a country house containing from five to twenty persons and for a small village with a population of about 400 deserve the notice of authorities in charge of rural sanitation in our country.

The account would have been still more interesting if it contained a little more information on the micro-organisms in sewage purification systems. The purification is brought about by micro-organisms which, as Duclaux described them many years ago, "are the important, almost the only, agents of universal hygiene". Further advances in the field seem to depend not so much on the mechanical equipment associated with the purification system but on the scientific knowledge of the underlying principle of the purification process. The statement on p. 171, "Dissolved Oxygen must not exceed 6 parts per 100,000" is not clear.

The book is very well produced and the typography excellent, and it will be welcomed by those interested in sanitary science.

S. C. PILLAI.

**Books Received**

*Physiology of Voluntary Muscle—British Medical Bulletin*, Vol. 12, No. 3. (Published by the Medical Department, The British Council, 65, Davies Street, London, W.1), 1956. Pp. 161-236. Price 15 sh.

*Chemistry of Carbon Compounds (Aromatic Compounds)*, Vol. 3. Edited by E. H. Rodd. (Cleave-Hume Press, Ltd., London W.8), 1956. Pp. 687-1670. Price £ 8 10 sh.

*Proceedings of the First Congress on Theoretical and Applied Mechanics*, November 1-2, 1956. (Indian Society of Theoretical and Applied Mechanics, Kharagpur), 1956. Pp. viii + 284. Price Rs. 15.

*From Microphone to Ear—Modern Sound Recording and Reproduction Technique*. By G. Slot. (M/s. Philips Electrical Co., Ltd., 7 J. C. Madhab Road, Calcutta-20), 1956. Pp. 180. Price Rs. 9-8-0.

*Some Protozoan Diseases of Man and Animals—Anaplasmosis, Babesiosis and Toxoplasmosis*. Vol. 64. By C. Cole and 19 other authors. (Annals of the New York Academy of Sciences), 1956. Pp. 250. Price \$3.50.

*Effects of Natural Selection of Human Genotypes*. Vol. 65. By L. D. Dunn, Howard Levene and R. B. McConnell. (Annals of the New York Academy of Sciences), 1956. Pp. 32. Price \$1.25.

*Epidemic and Endemic Diarrheal Diseases of the Infant*, Vol. 66. By E. Neter and 54 other authors. (Annals of the New York Academy of Sciences), 1956. Pp. 300. Price \$3.50.

*Crop Pests and How to Fight Them*. (The Directorate of Publicity, Government of Bombay, Bombay), 1956. Pp. v + 204. Price Rs. 2.

## PROGRESS IN NUCLEAR ENERGY\*

AT the Geneva Conference on the Peaceful Uses of Atomic Energy, a wealth of information was presented some of which prior to the Conference was classified. All papers that were presented there together with the proceedings have now been published by the U.N.O. in sixteen volumes. As is bound to happen, the information here is all scattered and is often repeated. Need for a coherent account of the results made available at the Conference was therefore greatly felt and the Editors of "Progress in Nuclear Energy" have done a very useful job in bringing out this series. Series 1 deals with Physics and Mathematics, and Volume 1 of this series has recently come out with forewords by Sir John Cockcroft and V. F. Weisskopf. Most of the chapters in this volume are survey articles by different authors, based upon numerous papers presented by various countries. A few papers which were complete in themselves have been directly reproduced.

The first chapter deals with the thermal neutron cross-section data for  $U^{233}$ ,  $U^{235}$  and  $Pu^{239}$ . Drawing upon the experimental results of various laboratories, particularly in France, U.K., U.S.A. and U.S.S.R., the authors have given curves for fission and absorption cross-sections as functions of neutron energy. Measurements on the values of  $\eta$  (number of neutrons produced per thermal neutron absorbed) and  $\nu$  (number of neutrons produced per fission) have also been included in the chapter. The second chapter summarizes the present state of knowledge on the neutron resonance levels of fissile nuclei,  $U^{233}$ ,  $U^{235}$  and  $Pu^{239}$  in the energy range 0-50 ev. All observed resonances have been carefully analysed and the resonance parameters tabulated. The data presented in these two chapters is mainly drawn from the Geneva papers and unpublished reports, and should be of great use to both theoretical and experimental physicists. In the third chapter Bethe analyses theoreti-

cally the neutron resonances in non-fissile and fissile materials under various assumptions and compares these with experiment.

Other good survey articles are on the techniques for measuring elastic and inelastic scattering cross-sections, neutron capture cross-section in  $Xe^{135}$ , resonance capture integral and delayed neutrons from the fission of  $U^{233}$ ,  $U^{235}$ ,  $U^{238}$ ,  $Th^{232}$  and  $Pu^{239}$ . Needless to say, apart from their intrinsic interest, a knowledge of the quantities discussed here is of great importance in reactor calculations.

The last four articles discuss the theory and try to compare the results of calculations with experiment for various types of reactors. The first of this series is on homogeneous reactors. Because of the possibility of breeding in such reactors, they have acquired special importance and the various theoretical and experimental results discussed here should be of interest to reactor physicists. Fast reactors are discussed in the next chapter and probably this is the only comprehensive account on such reactors available in print. In chapter 10 Feinberg discusses a method for calculating the critical mass for a small heterogeneous reactor. This method should be particularly useful for reactors using enriched fuel and when all fuel rods are not of the same dimensions or may in fact be of different materials. Highly enriched assemblies in which fission is caused mainly by neutrons of intermediate energy rather than by those of thermal energy, are discussed in the last chapter. Here also not much published literature is available on this subject outside this report.

Some important topics, like exponential experiments, measurements of diffusion length and slowing down age; neutron cross-sections for fissile materials in the high energy range have not found a place here and it is hoped that they will be fully discussed in subsequent volumes of series I. The book on the whole presents very important data and methods for making calculations on various types of reactor assemblies. It would prove extremely valuable to reactor physicists.

\* *Progress in Nuclear Energy*, Series I, Physics and Mathematics, Vol. I. Edited by Charpie, Hughes, Horowitz and Littler. (Pergamon Press, London), 1956. Pp. x + 398, Price 84 s/s.

## SCIENCE NOTES AND NEWS

### Intertrappean Fossil from Near Bombay

Messrs. R. N. Sukheswala and D. N. Elchidana, Department of Geology, St. Xavier's College, Bombay-1, have reported for the first time the occurrence of fossil fishes in the intertrappean beds near Dongri of the Salsette Island, Bombay. The fossils are very imperfectly preserved; and according to the late Dr. S. L. Hora who examined three of these specimens,—they represent the suborder Percoidei, and probably belong to the family Apogonidae which ranges in time from the Eocene to Recent.

### Blue Peroxy Chromic Acid

Sri. Ram Chandra Rai, Chemical Laboratories, Saugar University, Sagar, M.P., reports that blue peroxy chromic acid has been prepared even without the addition of acids. An aqueous solution of 5% potassium dichromate was cooled in ice, and to this ice-cooled hydrogen peroxide was added which gives a black substance. If to the above mixture 5% ice-cooled aqueous solution of  $\text{AgNO}_3$ ,  $\text{BaCl}_2$ ,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{SnCl}_4$ ,  $\text{SnCl}_2$ , uranium nitrate, zirconium nitrate, thorium nitrate, cerous sulphate or ceric sulphate was added, the blue peroxy chromic acid was formed which can be separated with ether from the aqueous layer. The blue peroxy chromic acid could not be obtained if, in place of the above, salt solutions of  $\text{SrCl}_2$ ,  $\text{Ca}(\text{NO}_3)_2$ ,  $\text{MgCl}_2$ ,  $\text{Ni}(\text{NO}_3)_2$ ,  $\text{Co}(\text{NO}_3)_2$ ,  $\text{ZnSO}_4$ ,  $\text{MnCl}_2$ ,  $\text{Pb}(\text{CH}_3\text{COO})_2$ ,  $\text{HgCl}_2$ ,  $\text{CuSO}_4$  and gold chloride, aluminium chloride, thallous and thallic nitrates were added.

### Miniature Batteries for Scientific Apparatus

National Carbon Company, India, announce they are now in a position to manufacture a variety of miniature batteries, including several types of medium and high voltage batteries, using the 'Eveready' 'Mini-Max' flat-cell construction. Users of electronic equipment such as Radiation Detectors and Monitors, Cosmic Ray Research Equipment, portable Seismographs, etc., etc., who wish to avoid the recurrent delay, inconvenience and expense of importing batteries for their equipment, are invited to communicate their battery requirements to the Development Engineer, National Carbon Co. (India), Ltd., P.O. Box 2170, Calcutta, giving pertinent information on the size of battery, voltage, available compartment

space, maximum permissible weight, and if possible, the brand and type number of the original battery component. National Carbon Company can then recommend suitable replacement batteries. Should it not be feasible to manufacture equivalent batteries in India, the Company may be able to assist users in obtaining the required batteries more readily from abroad.

### Origin of Salt in Rajasthan

Discussing the various theories which have been proposed to account for the vast accumulation of salt in Rajasthan (N.-W. India), T. R. Seshadri and G. M. Sakena, Department of Chemistry, Delhi University, observe in a recent paper (*J. Sci. Indust. Res.*, 1956, 15 A, p. 505) that it may be attributed to the underground flow of water from the north and north-west areas which were originally covered by sea and hence are rich in salt. The underground streams not only get laden with salt, but in their passage through certain areas suffer base exchange losing potassium, magnesium and bromide ions. These elements, normally present in sea-water, are found in deep well-waters of the areas mentioned above but are absent in the Sambhar and Didwana brines. The presence of carbonates and sulphates of sodium in Sambhar and Didwana brines is attributed to the lime and gypsum strata in the areas through which the brine has to pass.

### Chemical Effect of Gene Mutation

During the recent meeting of the British Association at Sheffield, Dr. V. M. Ingram, of the Medical Research Council's unit at the Cavendish Laboratory, Cambridge, showed for the first time how a mutation in a single gene can modify chemical structure in a substance in the body for which that gene is responsible.

The gene is that of sickle-cell anaemia, common mainly among Negroes. When inherited from only one parent it is believed to provide some degree of protection against malaria presumably because the blood cells of those so affected afford a less good supply of oxygen to malaria parasites. When inherited from both parents it causes severe anaemia, and few so affected survive to maturity. The fact that sickle-cell anaemia is determined by mutation in a single gene has been shown earlier in the United States.

Dr. Ingram's contribution has been to show that there is a chemical difference between hæmoglobin of normal individual and those with sickle-cell anæmia, people with the intermediate condition giving probably a mixture of hæmoglobins. H<sub>2</sub> has done this by breaking down the complete protein, which is hæmoglobin, into 30 fragments and separating these as spots on a sheet of filter-paper by the well known method of chromatography. Twenty-nine of the spots fell in the same positions in both cases. The thirtieth spot fell in different positions, according to whether the hæmoglobin was from a normal individual or one with sickle-cell anæmia. The fragment of the protein molecule which this spot represented is therefore chemically distinct in the two cases. It is probably a chain containing some 10 or so amino-acids, but its exact composition in the two cases is yet to be determined.

#### Bulletin of Polish Medical History and Science

The inaugural number of the above Journal has just been issued. Explaining its aims and objects, Dr. Alexander Rytel, Editor-in-Chief, observes that the hostilities of 1939-45 left Poland the most devastated country in the world and annihilated the works of generations of scientists. But medical centres have since been reconstructed and rehabilitated, and the Polish Medical Alliance seeks to present to the English-speaking physician the outstanding research works, both past and present, along with a résumé of the accomplishments of Polish medicine. The Journal has been very attractively produced, and contains sections devoted to original articles, abstracts of Polish Medical Literature and List of Articles published in the Polish Medical Press. Issued by the Polish Medical Alliance, its Editorial and Business Office is located at: 2424 North Kedzie Blvd., Chicago-47, Illinois, U.S.A. The Journal has our heartiest good wishes.

#### The Royal Society and Nuffield Foundation Commonwealth Bursaries Scheme

The Royal Society of England awarded a bursary under the above scheme to Dr. Vetury Ramakrishna Rao, Reader in Physics, Andhra University, Waltair, to study under Prof. J. T. Randall, the latest techniques in microspectrography at King's College, London, for a period of three months.

#### IX Indian Pharmaceutical Congress

The Ninth Indian Pharmaceutical Congress will be held in Calcutta from January 6-January 9, 1957. The Congress is being jointly

organised by the Indian Pharmaceutical Congress Association and the Indian Pharmaceutical Association. The Executive Committee of the Congress has decided to devote the Congress to the formulation of a Five-Year Plan for the Pharmaceutical Industry. The Congress will have the following sections: Professional Development; Pharmaceutical Education, Distribution of Drugs, Pharmaceutical Industry, Drugs Control Legislation, Hospital Pharmacy, Pharmaceutical Chemistry, Ayurvedic Section, Pharmacology, Pharmacy and Pharmacology.

A Pharmaceutical Exhibition is also being organised concurrently with the Congress. Further details can be obtained from Mr. A. McGee, 2, Heysham Road, Calcutta-20.

#### Symposium on Raw Hides and Skins Curing and Preservation

A symposium on Raw Hides and Skins—Curing and Preservation is to be held at the Central Leather Research Institute by the end of January 1957. The scope of the symposium has been made particularly wide to facilitate the improvement of the quality and availability of raw hides and skins fetching better prices for the raw stock as well as the finished leathers. Further particulars about the symposium can be had from: The Assistant Director-in-Charge, Central Leather Research Institute, Madras-20.

#### Symposium on Coal Carbonization

A symposium on Coal Carbonization is to be held at the Central Fuel Research Institute in the middle of March 1957. Those intending to participate in the symposium are requested to send a short summary running upto 200 words before 15th January 1957. Further particulars can be had from: The Director, Fuel Research Institute, Jealgora P.O., Manbhum Dist., Bihar.

#### Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Geophysics to Sri. V. P. Subrahmanyam for his thesis entitled, "Study of the Water Balances of India and the Vicinity from Climatic Data".

The Utkal University has awarded the Ph.D. Degree in Zoology to Sri. P. N. Chatterji for his thesis entitled, "Studies on Some Indian Trematodes".

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri K. P. Sinha for his thesis entitled, "The Theory and Mechanism of Solid-Solid Reactions".





# UNUSUAL LESION IN THE SUBCUTIS OF A FOWL, DUE TO THE FUNGUS OF *ASPERGILLUS* SP.

A FORMALIN fixed specimen from an Indian fowl was forwarded by the Veterinary Officer, Sirpur Veterinary Dispensary, to the Pathology Department of Bombay Veterinary College, for histopathological examination and report. The clinical history accompanying the specimen states that the bird with a hard lump on the ventral aspect of its abdomen, and of six months' duration was brought there for treatment. On examination and manipulation, it was noticed that the skin was torn and a hard lump was present in the subcutaneous region. This was easily removed by twisting. It is further reported that the bird has recovered after the removal of the lump which was suspected to be only a dry mass of fat.

The lump was found to be a spherical body measuring about 6 cm. in diameter and weighing 2 oz. On cutting through the specimen, it was seen to be made up of concentric laminations resembling those of an onion and having a necrotic centre (Fig. 1).



FIG. 1. Gross specimen showing distinctly the onion-like laminations and the necrotic centre.

Microscopic examination shows that the laminæ are made up of tissue which has de-

generated beyond identity and a network of fungus mycelia which are clearly noticeable on either surface of the laminæ. The space in between the laminæ is occupied by mycelia, and amongst them can be seen a number of mature conidiophores and free conidia, identical to those of *Aspergillus* species (Fig. 2). The



FIG. 2. Highly magnified view showing the mycelia and spores. One conidiophore with columella and sterigmata is distinctly seen.

particular species of the fungus involved, could not be determined as the specimen was sent fixed in formalin.

The finding of this peculiar lesion due to *Aspergillus* fungus, at an unusual site, is surprising. It would, therefore, be interesting to find out if such a lesion is common, whether this has any relation with the abdominal airsacs which are sometimes involved in *Aspergillus* infections, and the particular species of the *Aspergillus* fungus involved in such lesions.

Bombay Veterinary College, R. M. KALAPESI.  
Parel, Bombay-12, B. L. PUROHIT.  
July 30, 1956.

1. Schlegel, M., Cited by Bullis, K. L., *Disease of Poultry*, by H. E. Biester and Louis Devries, The Iowa State College Press, 1945.

### A NEW TECHNIQUE FOR THE CONSTRUCTION OF DYKES IN DEEP-SILTED SWAMPS

THERE are extensive swamps in many States of India, which are at present lying derelict. Reclamation of such swamps into fish ponds has been recognised as an effective means of making them productive (Wilson,<sup>1</sup> Schuster *et al.*<sup>2</sup>). Since 1949 a scheme for the reclamation of swamps has been in progress in the State of Orissa and upto now over 30 swamps have been converted into productive fish farms. The author has in a recent article<sup>3</sup> described the methods adopted for swamp reclamation in Orissa, which mainly consist of eradication of weeds, dewatering, construction of dykes and their turfing and provision of sluices. Experience so far gained in the culture of fish in reclaimed swamps has shown that it is more profitable to construct fish ponds in deep-silted swamps which are very productive. But the construction of dykes in such swamps has presented great difficulties and it has been found impossible to complete the central dykes in them even when the silt is allowed to settle for one year before piling of silt next year.

For the construction of dykes, generally the swamp is dewatered by draining or by means of power pumps and the surface of the swamp bed is dried to a depth of 9" to 12". Earthwork is then done by manual labour and silt is piled up on the dyke. But a slushy mass remains below the crust and the pile of silt after attaining a certain height spreads out and the dyke flattens itself. Any further piling of silt does not raise the dyke but causes greater flattening, even when pile driving is resorted to.

During this year a new technique was tried for the reclamation of Kiakani swamp in Orissa (36 acres in area) which had a silt deposit of 8 ft. to 12 ft. This technique which is described below was found very successful and it was possible to complete the reclamation work of this swamp in one working season extending from February to June.

In the new technique, a silt retaining wall with good cohesive resistance is formed by subsoil pumping instead of pumping on the surface. The water-level is maintained at about 4 ft. to 5 ft. below the crust by round the clock pumping and then the silt forms a solid mass. Being impervious, this mass does not allow seepage of water from the bottom, provided pumping is constantly done to maintain the subsoil water-level. This second crust serves as a berm to hold the silt in position and as more and more silt is piled up and the load in-

creases in the centre, the downward thrust of the silt clods is counteracted and the surface of the retaining wall on both sides raises itself to convex slopes. The upward thrust is indicated clearly by typical fissures of the clods which are wider on the surface and narrower below. The self-raising berm is caused by the upward thrust of the second component, while the first one keeps the piled up silt in position. Centrally piled up silt together with the convex ledge of the berm can then be aligned to make a perfect and permanent embankment. In Kiakani, subsoil pumping was done to a depth of 5 ft. and drains running from several points of the swamps were excavated to the pumping pit. Dykes were made 120 ft. wide at the base but the silt was piled only on about 20 ft. at the centre, the rest forming the self-raising berm. The dykes which were 12 ft. to 15 ft. in height became quite stable by this method and it withstood very well this year's unusually heavy rains in the area.

The new technique of constructing dykes does not involve any additional expenditure, but has the great advantage that the work can be completed in one season and the dykes thus constructed are permanent and strong. This technique is now being followed for the reclamation of several swamps in the State, with very encouraging results and it is likely that this method can be adopted with advantage in similar work conducted in other areas in the country.

Dept. of Fisheries,  
Cuttack, August 22, 1956.

G. N. MITRA.

1. Wilson, H. C., *Madras Fish. Bull.*, 1917, 11, 161.
2. Schuster, W. H., Kestenen, G. L. and Colling G. E. P., *F.A.O. Fisheries Study*, 1954, No. 3.
3. Mitra, G. N., *Progress of Fisheries Development in India*. Published by the Executive Committee All-India Fisheries Exhibition, 1956, 54-61.

### EMBRYO SAC HAUSTORIA IN CASSYTHA FILIFORMIS LINN.

THE only available information on the embryology of the parasitic twiner *Cassytha filiformis* is contained in some casual observations of Mirande<sup>1</sup> on the structure of the ovule, fruit and seed. An embryological study of the species by the author revealed an overwhelming similarity with other members of Lauraceae in respect of structure and development of anther, pollen, carpel, ovule, fruit and seed. However, the behaviour of the female gametophyte proved to be unique for Lauraceae and is briefly described in this communication.

# UNUSUAL LESION IN THE SUBCUTIS OF A FOWL, DUE TO THE FUNGUS OF *ASPERGILLUS* SP.

A FORMALIN fixed specimen from an Indian fowl was forwarded by the Veterinary Officer, Sirpur Veterinary Dispensary, to the Pathology Department of Bombay Veterinary College, for histopathological examination and report. The clinical history accompanying the specimen states that the bird with a hard lump on the ventral aspect of its abdomen, and of six months' duration was brought there for treatment. On examination and manipulation, it was noticed that the skin was torn and a hard lump was present in the subcutaneous region. This was easily removed by twisting. It is further reported that the bird has recovered after the removal of the lump which was suspected to be only a dry mass of fat.

The lump was found to be a spherical body measuring about 6 cm. in diameter and weighing 2 oz. On cutting through the specimen, it was seen to be made up of concentric laminations resembling those of an onion and having a necrotic centre (Fig. 1).

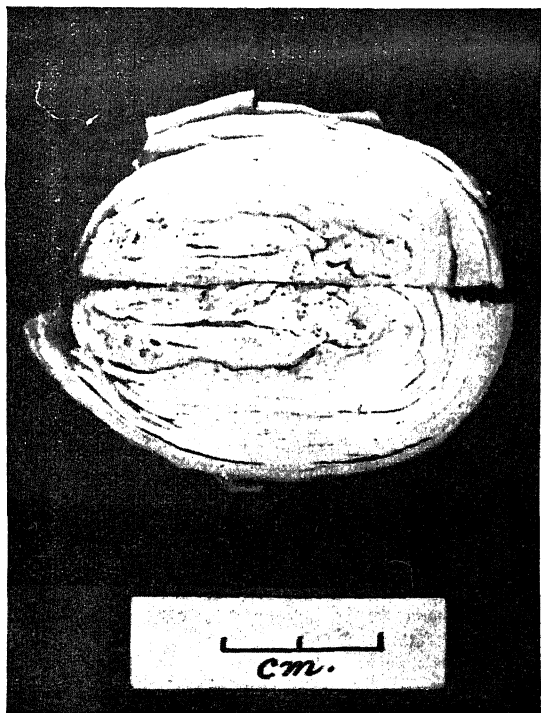


FIG. 1. Gross specimen showing distinctly the onion-like laminations and the necrotic centre.

Microscopic examination shows that the laminæ are made up of tissue which has de-

generated beyond identity and a network of fungus mycelia which are clearly noticeable on either surface of the laminæ. The space in between the laminæ is occupied by mycelia, and amongst them can be seen a number of mature conidiophores and free conidia, identical to those of *Aspergillus* species (Fig. 2). The



FIG. 2. Highly magnified view showing the mycelia and spores. One conidiophore with columella and sterigmata is distinctly seen.

particular species of the fungus involved, could not be determined as the specimen was sent fixed in formalin.

The finding of this peculiar lesion due to *Aspergillus* fungus, at an unusual site, is surprising. It would, therefore, be interesting to find out if such a lesion is common, whether this has any relation with the abdominal airsacs which are sometimes involved in *Aspergillus* infections, and the particular species of the *Aspergillus* fungus involved in such lesions.

Bombay Veterinary College. R. M. KALAPESI.  
Parel, Bombay-12, B. L. PUROHIT.  
July 30, 1956.

1. Schlegel, M., Cited by Bullis, K. L., *Disease of Poultry*, by H. E. Biester and Louis Devries, The Iowa State College Press, 1945.

## A NEW TECHNIQUE FOR THE CONSTRUCTION OF DYKES IN DEEP-SILTED SWAMPS

THERE are extensive swamps in many States of India, which are at present lying derelict. Reclamation of such swamps into fish ponds has been recognised as an effective means of making them productive (Wilson,<sup>1</sup> Schuster *et al.*<sup>2</sup>). Since 1949 a scheme for the reclamation of swamps has been in progress in the State of Orissa and upto now over 30 swamps have been converted into productive fish farms. The author has in a recent article<sup>3</sup> described the methods adopted for swamp reclamation in Orissa, which mainly consist of eradication of weeds, dewatering, construction of dykes and their turfing and provision of sluices. Experience so far gained in the culture of fish in reclaimed swamps has shown that it is more profitable to construct fish ponds in deep-silted swamps which are very productive. But the construction of dykes in such swamps has presented great difficulties and it has been found impossible to complete the central dykes in them even when the silt is allowed to settle for one year before piling of silt next year.

For the construction of dykes, generally the swamp is dewatered by draining or by means of power pumps and the surface of the swamp bed is dried to a depth of 9" to 12". Earthwork is then done by manual labour and silt is piled up on the dyke. But a slushy mass remains below the crust and the pile of silt after attaining a certain height spreads out and the dyke flattens itself. Any further piling of silt does not raise the dyke but causes greater flattening, even when pile driving is resorted to.

During this year a new technique was tried for the reclamation of Kiakani swamp in Orissa (36 acres in area) which had a silt deposit of 8 ft. to 12 ft. This technique which is described below was found very successful and it was possible to complete the reclamation work of this swamp in one working season extending from February to June.

In the new technique, a silt retaining wall with good cohesive resistance is formed by subsoil pumping instead of pumping on the surface. The water-level is maintained at about 4 ft. to 5 ft. below the crust by round the clock pumping and then the silt forms a solid mass. Being impervious, this mass does not allow seepage of water from the bottom, provided pumping is constantly done to maintain the subsoil water-level. This second crust serves as a berm to hold the silt in position and as more and more silt is piled up and the load in-

creases in the centre, the downward thrust of the silt clods is counteracted and the surface of the retaining wall on both sides raises itself to convex slopes. The upward thrust is indicated clearly by typical fissures of the clods which are wider on the surface and narrower below. The self-raising berm is caused by the upward thrust of the second component, while the first one keeps the piled up silt in position. Centrally piled up silt together with the convex ledge of the berm can then be aligned to make a perfect and permanent embankment. In Kiakani, subsoil pumping was done to a depth of 5 ft. and drains running from several points of the swamps were excavated to the pumping pit. Dykes were made 120 ft. wide at the base but the silt was piled only on about 20 ft. at the centre, the rest forming the self-raising berm. The dykes which were 12 ft. to 15 ft. in height became quite stable by this method and it withstood very well this year's unusually heavy rains in the area.

The new technique of constructing dykes does not involve any additional expenditure, but has the great advantage that the work can be completed in one season and the dykes thus constructed are permanent and strong. This technique is now being followed for the reclamation of several swamps in the State, with very encouraging results and it is likely that this method can be adopted with advantage in similar work conducted in other areas in the country.

Dept. of Fisheries,  
Cuttack, August 22, 1956.

G. N. MITRA.

1. Wilson, H. C., *Madras Fish. Bull.*, 1917, 11, 161.
2. Schuster, W. H., Kestenen, G. L. and Colling, G. E. P., *F.A.O. Fisheries Study*, 1954, No. 3.
3. Mitra, G. N., *Progress of Fisheries Development in India*. Published by the Executive Committee All-India Fisheries Exhibition, 1956, 54-61.

## EMBRYO SAC HAUSTORIA IN CASSYTHA FILIFORMIS LINN.

THE only available information on the embryology of the parasitic twiner *Cassytha filiformis* is contained in some casual observations of Mirande<sup>1</sup> on the structure of the ovule, fruit and seed. An embryological study of the species by the author revealed an overwhelming similarity with other members of Lauraceae in respect of structure and development of anther, pollen, carpel, ovule, fruit and seed. However, the behaviour of the female gametophyte proved to be unique for Lauraceae and is briefly described in this communication.

## CHROMOSOME BREAKAGE INDUCED BY VEGETABLE OILS AND EDIBLE FATS

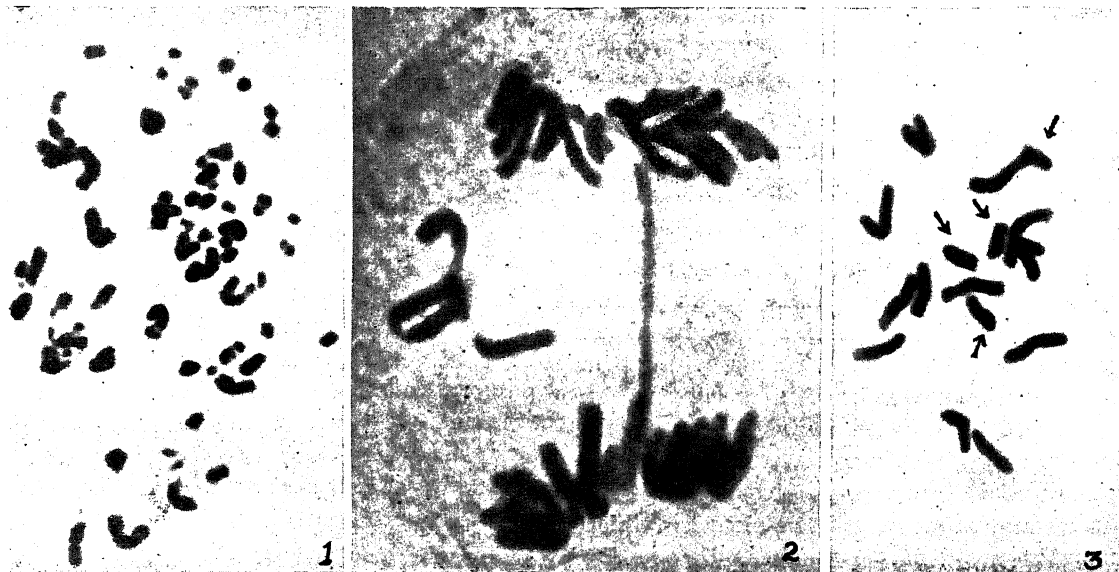
M. S. SWAMINATHAN AND A. T. NATARAJAN

Indian Agricultural Research Institute, New Delhi

DURING the course of mutation research in progress at the Indian Agricultural Research Institute, the earlier findings of Gustafsson<sup>1</sup> and other workers that there are marked differences in sensitivity to radiation among different crop plants was confirmed.<sup>2</sup> It was found that some oilseed plants like linseed are much less sensitive to radiation with X-rays and  $\beta$ -particles from  $^{32}\text{P}$  and  $^{35}\text{S}$  than cereals like wheat and paddy. It was considered likely that the presence of oil in seeds might have a buffering effect on radiation, and in an experiment designed to elicit information on this problem, seeds of several plants were first soaked in some vegetable oils and edible fats and later subjected to irradiation. In this experiment, controls with no treatment and with seeds soaked in oils for various durations but not subsequently irradiated were kept. Observations on preparations of root tip mitosis made from this material showed that immersion in the oils alone caused chromosome

breakage in many cells. A summary of the results is presented in this paper.

Dry seeds of *Triticum monococcum*, *T. dicoccum*, *T. aestivum*, *Oryza sativa* and *Vicia faba* were soaked for different durations extending from 6 minutes to 6 hours in the following oils and fats (the pure oils had been extracted at the Division of Chemistry of this Institute): mustard oil from *Brassica campestris* var. *toria*, groundnut oil, castor oil, gingelly oil, coconut oil, linseed oil, hydrogenated groundnut oil and ghee. After being soaked in oil, the seeds were thoroughly wiped with cloth and sown in petri-dishes over moist filter-paper. Soaking for two or more hours in linseed oil and groundnut oil completely inhibited the germination of seeds. Germination was reduced to varying extents in the other treatments. Root tips were fixed 24, 48 and 96 hours after germination in a mixture of 3 parts of alcohol and 1 part of acetic acid for a day and later stained with leuco-basic



FIGS. 1-3. Mitosis in *T. monococcum* root tips treated with oils. Fig. 1. Mustard oil treatment for 2 hours showing extreme chromosome fragmentation. Fig. 2. Anaphase in mustard oil treated cell with one dicentric bridge and a point error configuration. Fig. 3. Castor oil treatment for two hours showing 12 chromosomes and 4 fragments (arrows). Note that the treatment leads to the contraction of chromosomes, thus facilitating their spread.

(Figs. 1 and 3,  $\times 900$ ; Fig. 2,  $\times 1800$ .)

fuchsin and squashed. Preparations were also made from control seeds sown either dry or after soaking in water for 2 to 6 hours.

Cell division was normal in the root tips of control seeds. Analysis of metaphase and anaphase plates in preparations made from treated root tips showed several aberrations like chromosome and chromatid breakages, minute fragments, dicentric bridges and acentric fragments and 'error' bridges probably arising from subchromatid breakages<sup>3</sup> (Figs. 1 to 3). Treatment with the oils, especially castor oil, led to the contraction of chromosomes thereby facilitating their clear spread in squash preparations.<sup>4</sup> No stickiness among the chromosomes was caused by the treatment. In several cells, the two chromatids of a chromosome were asymmetrically broken, thus indicating that they were separately and independently affected. There was also practically no reunion among the chromosome fragments. These observations would indicate that breakage occurs near to the time of chromosome reduplication and also is spread over a period of time. There were some tetraploid cells in the treated root tips, which appeared to have arisen by failure of cytokinesis, since there was no evidence of interference with anaphase movement. Binucleate cells were present lending support to the view that cell division was disturbed. Some binucleate cells showed non-synchronised mitosis, one nucleus being at the resting stage and the other at prophase or metaphase.

The standard *Allium* test of Levan<sup>5</sup> was performed using mustard and gingelly oils and it was found that mustard oil treatment for half to one hour caused the formation of tumours in *Allium* root tips and also induced chromosome breakage. The recovery of the cells from the effects of the treatment was, however, rapid and meristems developed subsequently to the treatment hardly showed aberrant cells. In comparison with mustard oil, gingelly oil had no adverse effects on *Allium* root tip cells.

The data obtained from *T. monococcum* seeds treated with the different oils and fats are summarised in Table I. It will be seen from this table that groundnut and mustard oils produce the largest and gingelly oil and ghee the lowest number of aberrant cells. Such diverse action probably arises from the differences in the fatty acid components of these oils, since we found that very few cells are affected when seeds are treated with glycerol. Auerbach<sup>6</sup> reported that the essential oil of mustard (allyl-iso-thiocyanate) had mutagenic properties but she was doubtful whether it produced chromosome aberrations. It was subsequently shown by D'Amato and Avanzi<sup>7</sup> that allyl-iso-thiocyanate is not capable of producing chromosome breakage. It is reported from studies in *Drosophila* that gingelly oil<sup>8</sup> and groundnut oil<sup>9</sup> have no mutagenic properties. We are now engaged in studying the number of division cycles over which the aberrations are carried forward and the cytological effects of the fractionated components of different fats and oils.

TABLE I  
Chromosome breakage induced in *Triticum monococcum*

Treatment	Duration of treatment	Percentage of germination	Metaphase			Anaphase		Cells with aberrations (per cent.)
			No. of cells studied	No. of cells with aberrations	Range of breaks per cell	No. of cells studied	No. of cells with aberrations	
Water	.. 2 hrs.	100	Numerous	nil	..	..	..	..
Mustard oil	.. 6 mts.	70	267	29	1-18	115	12	10.7
"	.. 2 hrs.	40	213	52	1-21	141	20	20.3
"	.. 6 hrs.	20	486	102	1-24	245	49	22.6
Groundnut oil	.. 1 hr.	20	149	46	1-28	61	6	24.8
"	.. 2 hrs.	0	..	..	..	..	..	..
Castor oil	.. 2 hrs.	40	97	15	1-16	24	4	16.5
Linseed oil	.. 1 hr.	20	75	13	1-7	61	4	12.5
"	.. 2 hrs.	0	..	..	..	..	..	..
Hydrogenated groundnut oil	.. 2 hrs.	20	60	10	1-21	53	3	11.8
Coconut oil	.. 2 hrs.	80	205	29	1-38	294	27	9.2
Gingelly oil	.. 2 hrs.	50	123	3	1-2	137	2	1.9
"	.. 6 hrs.	20	182	16	1-28	168	3	5.4
Ghee	.. 2 hrs.	80	107	7	1-5	109	3	4.7

The results will help to find out whether oils like those of mustard, groundnut and castor can be used for inducing mutations in plants and to isolate the component of the oil which causes the chromosome breakage. Since the mustard oil group consists of several types with varying pungency, the action of each of them is being separately estimated.

The results presented in this paper are of great interest in view of the relationship between mutagenicity and carcinogenicity. The discovery of the mutagenic effect of ionizing radiation, an agent already known to be carcinogenic, provided the first evidence in support of the somatic mutation hypothesis of malignancies. Muller<sup>10</sup> has pointed out that a comparative survey of the results not only with radiations of different types but also with chemical mutagens suggests the view that the effects of these agents on genes and chromosomes forms the basis of their effects in producing malignancies. The role of nutrition with reference to the incidence of cancer is now widely realised and there are indications that a search for carcinogenic compounds in human dietary regimens might be worthwhile. Many fats and oils are known to be capable of promoting and inducing the formation of skin and mammary tumours in rats. Differences in the action of the different oils have also been observed. Thus, increasing the corn oil content from 5% to 20% of the diet strikingly enhanced tumour formation in rats but replacing the 5% corn oil with 20% partially hydrogenated cotton seed oil or 20% lard produced no appreciable augmentation.<sup>11</sup> Such differential action of different fats has not yet been explained in terms of their chemical, physical or biological pro-

perties. Whether there are differences in the action of these oils on the nucleus, similar to the observations recorded by us, remains to be ascertained.

The present study has been carried out only in plant meristems, and it is not known whether comparable effects will be produced in dividing animal tissues. There is, however, evidence that the action of chemical mutagens such as nitrogen mustard, like that of radiation, is general and organisms of various kinds like bacteria, fungi, higher plants and mammals are equally affected.<sup>10</sup> In view of the fact that some of the oils and fats mentioned in this paper are widely used as cooking media in tropical countries, the present data deserve the attention of medical and cancer research workers.

We are indebted to Dr. B. P. Pal and Dr. S. M. Sikka for their interest in the study and encouragement.

1. Gustafsson, A., *Hereditas*, 1944, **30**, 165.
2. Sikka, S. M. and Swaminathan, M. S., *Science and Culture* (in press).
3. LaCour, L. F. and Rutishauser, A., *Chromosoma*, 1954, **6**, 696.
4. Swaminathan, M. S. and Natarajan, A. T., *Stain Techn.* (in press).
5. Levan, A., *Proc. 8th International Genetics Congress, Hereditas Suppl.*, 1949, 325.
6. Auerbach, C. and Robson, J. M., *Nature*, 1944, **154**, 81.
7. D'Amato, F. and Avanzi, M. G., *Caryologia*, 1949, **1**, 175.
8. Demerec, M., *Genetics*, 1948, **33**, 337.
9. Bird, M. J., *Nature*, 1950, **165**, 491.
10. Muller, H. J., *Radiation Biology*, 1954, **1**, 351.
11. Tannenbaum, A. and Silverstone, H., *Advances in Cancer Research*, 1953, **1**, 451.

### UNESCO'S FIRST TEN YEARS

AN account of UNESCO's achievements over the first decade of its existence is given in an illustrated booklet published by the Organisation under the title, "Ten Years of Service to Peace". It assesses the contribution made in various branches of education, the sciences and the arts towards better understanding between nations.

This contribution is translated into a wealth of facts and figures. For instance, on UNESCO's initiative, more than 10,000 libraries in over 100 countries and territories are now exchanging publications. International fundamental education centres set up by UNESCO in Patzcuaro (Mexico) and Sirs-el-Layyan (Egypt) have already trained more than 300 teachers in

methods of improving life in rural areas. These teachers are now passing on their knowledge to others in remote parts of their countries in Latin America and the Middle East. More than 3,000 workers representing almost every trade have, through the Exchange of Persons programme, had an opportunity of visiting their counterparts in other lands. Through UNESCO's share in the United Nations Technical Assistance Programme, over 450 fellowships have been awarded to young men and women from less developed regions to train as engineers and scientists. The booklet provides many other examples of what UNESCO is doing to assist countries in solving their educational, scientific and cultural problems.



# GROWTH OF THE SAND BAR NORTH OF THE GODAVARI CONFLUENCE

C. MAHADEVAN AND R. PRASADA RAO

*Dept. of Geology, Andhra University, Waltair*

LA FOND AND PRASADA RAO<sup>1</sup> in their detailed paper on the erosion at Uppada attributed the erosion to the alteration of the circulation pattern in the Kakinada Bay as well as near Uppada caused by the growth of the Godavari Point. The sand bar which was non-existent a hundred years ago has grown first northwards of the Godavari confluence, and later towards north-west. It is interesting to study the factors responsible for the development of the sand spit. Most of the river mouths on the east coast of India are characterised by the existence of sand bars extending usually northwards. A person flying from Madras to Calcutta may notice several such sand spits. This is believed to be due to the presence of strong northerly currents, coastal and longshore. The southerly currents caused by the north-east monsoon are too weak to build sand spits in a southerly direction at the confluences.

Poornachandra Rao and Mahadevan<sup>2</sup> found that between Godavari Delta and Waltair, the offshore sediments contained green pyroxene, amphibole and plagioclase in small amounts when compared with garnet and zircon which are present in appreciable amounts. Colourless mica and kyanite also appeared. The detrital mineral assemblages vary in their proportion of quartz, feldspar, sillimanite, zircon, garnet, monazite, bluish green amphibole and plagioclase feldspar. This mineral association is characteristic of the rock types occurring in the drainage basin of the Godavari River. Hence it is believed that most of the sediment in this region is brought by the river.

All the earlier surveys made in the area were consulted, for a detailed analysis of the changes in the region of the Godavari River distributaries. Some of the charts are reproduced and are shown in Plates I, II and III. Plate I shows that Godavari Point was not existing in the year 1851. The present Kakinada Bay was mostly dry during the low waters. The Godavari River discharged its water through an opening towards east. A small sand bar exposed only at low tides was present. The shape of this shows an unmistakable northerly drift of sand at that time. By 1864 the 'sand bar' exposed at low tides became a full-fledged sand spit, resulting in the birth of the Godavari Point. The river was discharging its waters mainly northwards, although a small opening

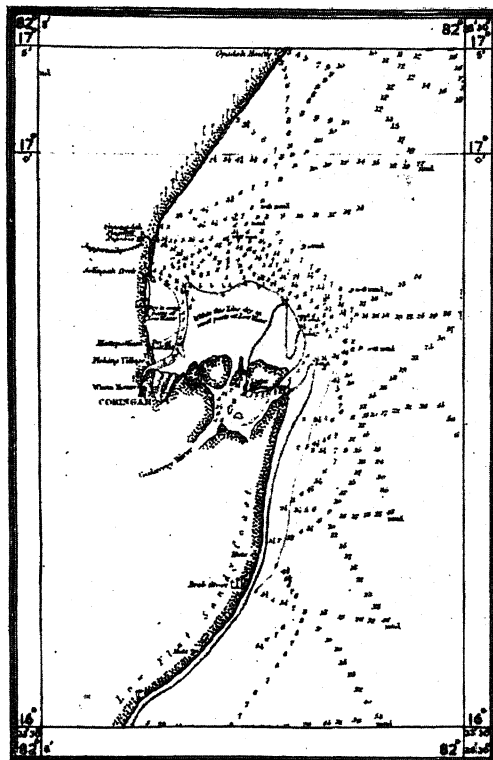


PLATE I. Admiralty Chart of the survey made in 1851, in the region of Godavari Distributaries and Coringah (Kakinada) Bay.

eastward was present at the time. During this period, the Hope Island took its present shape. A bay off Kakinada Town was formed which was previously known as Coringah Bay and now called Kakinada Bay. The bay appeared to have become deeper, the low mud flats were cut probably by the Godavari discharge.

The Godavari Point grew northwards by 1878 and the river was discharging its waters into the Kakinada Bay instead of directly into the sea, since the eastern channel has been completely silted up. The Sacramento Shoals (10 miles south of Kakinada) were slowly appearing by that time. A process of siltation was taking place north of Kakinada groyne. The subsequent charts upto 1893 show a still further development of Godavari Point northwards, the formation of Sacramento Shoals, and the accretion of sand north of the Kakinada groyne. The Godavari Point finally grew



## SCIENCE NOTES AND NEWS

### *Alternaria zinnæ* Pape. in India

*Zinnia elegans*, a common ornamental plant in Delhi gardens, has been found to be badly damaged by fungus which has been identified as *Alternaria zinnæ* Pape. Messrs. B. L. Chona and J. N. Kapoor, Division of Mycology and Plant Pathology, I.A.R.I., New Delhi, report this for the first time from Northern India.

### Utilisation of Plutonium

In a recent speech, Willard F. Libby, Commissioner, Atomic Energy Commission, U.S.A., urged chemists to learn a way of adapting the plutonium in atomic weapons for peaceful power uses. He challenged scientists to discover a way to "burn up" plutonium for fuel, should the day come when the weapons stockpile is considered large enough.

The fact that plutonium is highly dangerous has so far hindered its use in power development. Plutonium, like radiostrontium, emits alpha rays and accumulates in human bone. The need for increased safety precautions has so far made plutonium less attractive to experiment with than enriched uranium-235, the current source of power fuel.

### Aluminium with the Hardness of Steel

A new method of electrolysis, known as hard or deep anode treatment, has been elaborated by Professor N. D. Tomashev and M. N. Tyukina, at the Institute of Physical Chemistry of the USSR Academy of Sciences, which makes it possible to obtain an oxide layer of extreme hardness, firmly bound with the basic metal, on the surface of aluminium and its alloys. The thickness of this layer may be 100-150 microns and more, this being several times the thickness obtained by previous methods. The thick anode film obtained by this method considerably increases the resistance of aluminium alloys to wear and friction. Furthermore, it lends the surface heat-resistance and electric insulating properties, capable of standing a tension of 2,000 volts.

### Rocket Flight Around the Moon

Professor Chebotarev, of the Institute of Theoretical Astronomy of the USSR Academy of Sciences, has established the theoretical possibility of sending up a rocket for a flight

around the moon and the return to earth, carrying a smaller amount of fuel than has hitherto been considered necessary. Professor Chebotarev's calculations have shown that the rocket only needs fuel during the first period of its flight, after which it will continue to move under the influence of the gravity of the moon, sun and earth.

According to these computations, the rocket will travel a maximum distance of 400,000 km. from the earth. The distance between the earth and the moon is 384,000 km. The velocity of the rocket will drop from 11 km. per second at the start to nought as it approaches the moon. Thanks to this, the rocket will fly round the moon, thus making it possible to observe that planet from the side not visible from the earth. The entire flight will take 10 days and nights.

### Genetics Congress Resolution on Radiation Hazards

At the final session of the International Congress of Human Genetics which met recently in Copenhagen, Denmark, Herman J. Muller, of the University of Indiana, proposed the following resolution on radiation danger. It was passed unanimously by the approximately 400 participants.

"The damage produced by radiation on the hereditary material (of man) is real and should be taken seriously into consideration in both the peaceful and military uses of nuclear energy as well as in all medical, commercial and industrial practices in which X-rays or other ionizing radiation is emitted.

"It is recommended that the investigation of the amount and type of damage and of related genetic questions be greatly extended and intensified with a view of safeguarding the well-being of future generations."

### Scientific Aid to Fishing

The latest addition to the fisherman's scientific armoury, the Kelvin Hughes Fisherman's Asdic, will be on the world's markets about the middle of next year. It is a new application of the technique of transmitting acoustic pulses which rebound from solid bodies and are recorded back in the boat. An expert operator can interpret from the blips and smudges not only that he is passing over a shoal, but

how many fathoms down it is, and even what type of fish.

With the Asdic, used in conjunction with new types of vertical echo sounders introduced simultaneously by the same firm, the chance of a slip between tin and blip appears to be materially reduced; for the Asdic transmits horizontal pulses which will reveal the positions of shoals anywhere round the boat up to 2,000 yards range.

### *Physics and Chemistry of Solids*

The publication of an international research journal with the above title has been announced recently. The Journal will publish both theoretical and experimental papers dealing with original research in all aspects of the physical and chemical properties of solids and condensed systems. The principal fields of interest, however, will centre on (1) the electronic structure of solids and those physical and chemical properties which derive more or less directly from electronic structure, and (2) the fundamental statistical mechanics of condensed systems. Preference will be given to those contributions having the widest significance for the understanding of solid state properties in general, and emphasis will thus be on topics with some theoretical implications. The aim of the Journal is to bring together into a common forum the best contributions on the physics and chemistry of the solid state from all over the world. As in the case of *ACTA METALLURGICA*, it is a part of the purpose of the Journal to encourage greater interchange of ideas between physicists and chemists interested in solids. Other particulars can be had from the Editor-in-Chief, Professor Harvey Brooks, 224, Nyman Laboratory, Harvard University, Cambridge 38, Massachusetts, U.S.A.

### *Institution of Telecommunication Engineers, India*

The first Technical Convention of the Institution of Telecommunication Engineers, India, will be held on December 30, 1956, at the National Institute of Sciences Hall in New Delhi.

The Convention will be preceded by the Annual General Meeting of the Institution on

December 29, when Brig. Iyappa, the present President, will hand over charge of his office to the President-Elect, Prof. K. Sreenivasan, Head of the Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore.

At the Technical Convention, a number of papers on various aspects of telecommunication are expected to be presented. Those participating actively in the Convention include the National Physical Laboratory, Indian Institute of Science, Government Communication agencies such as All-India Radio, Posts and Telegraphs, State Industrial enterprises like Bharat Electronics and various Universities and colleges. The Convention, which is expected to be an annual feature, will provide for the first time in the country, a forum for all those working in the field of telecommunications to present papers and exchange information on topics of mutual interest.

### *Royal Institute of Chemistry, North India Section*

At the Annual General Meeting of the North India Section of the Royal Institute of Chemistry held recently, the following Office-bearers were elected for the year 1956-57. *President*: Dr. B. Viswanath; *Hony. Secretary and Treasurer*: Dr. G. S. Saharia; *Auditor*: Mr. B. N. Sastri.

### *Award of Research Degree*

The Andhra University has awarded the D.Sc. Degree in Chemistry to Shri D. Subrahmanyam for his thesis entitled "Some Studies in Cerate Oxidimetry".

The Gujarat University has awarded the Ph.D. Degree in Physics to Shri Shah Govindlal Zaverbhai for his thesis entitled "Nuclear Scattering of High Energy Nucleons".

The Madras University has awarded the Ph.D. Degree in Physics to Shri P. M. Mathews for his thesis entitled "On the Application of Some Recent Methods in Stochastic Theory to Physical Problems".

The Utkal University has awarded the Ph.D. Degree in Chemistry to Shri Hrushi Kesh Pujari for his thesis entitled "Preparation and Useful Applications of Some Thiazolidone Derivatives".

# Current Science

XXV]

DECEMBER 1956

[No. 12

	PAGE		PAGE
<i>m. Theory and Crystal Physics—</i>		<i>Nobel Award for Chemistry—1956—</i>	
<i>C. V. RAMAN .. .. .</i>	377	<i>M. SANTHAPPA .. .. .</i>	387
<i>some Breakage Induced by Vege-</i>		<i>Nobel Award for Physics—1956—K. S.</i>	
<i>Oils and Edible Fats—M. S.</i>		<i>CHANDRASEKHARAN .. .. .</i>	388
<i>TINATHAN AND A. T. NATARAJAN ..</i>	382	<i>Catalogue of Nuclear Reactors ..</i>	388
<i>O'S First Ten Years .. .. .</i>	384	<i>Letters to the Editor .. .. .</i>	389
<i>of the Sand Bar North of the</i>		<i>Reviews .. .. .</i>	405
<i>vari Confluence—C. MAHADEVAN</i>		<i>Progress in Nuclear Energy—K. S. SINGWI</i>	
<i>C. PRASADA RAO .. .. .</i>	385	<i>AND L. S. KOTHARI .. .. .</i>	408
		<i>Science Notes and News .. .. .</i>	409

## QUANTUM THEORY AND CRYSTAL PHYSICS\*

BY

SIR C. V. RAMAN

### 1. INTRODUCTION

physics of the twentieth century differs fundamentally from the physics of nineteenth mainly because of two known respectively as the Quantum and the Theory of Relativity which an integral part of its scheme of .. It is these two theories that have l a far deeper understanding of the of the physical world to be attained as possible at the end of the last . One must here acknowledge the

work of Albert Einstein who played the leading role in the development of both of these theories. His publications during the first two decades of the present century bear on every page the imprint of a powerful and penetrating intellect. Even after this lapse of years, the physicist of today will find the study of those papers a profitable and stimulating experience. Indeed, a good deal of what I have to say in this address only reflects the results of such a study in relation to the fundamental problems of the crystalline state of matter—a subject which has deeply interested me for several years past.

\*idential address to the Indian Academy of at Waltair, on the 26th December 1956.

## PROGRESS IN NUCLEAR ENERGY REACTORS\*

THE Geneva Conference on Atomic Energy resulted in the release of such a vast amount of information, that many attempts have been made to present this information in a compact and easily accessible form. The 'Progress in Nuclear Energy' Series does this in eight volumes, and the present volume is the second of the series and deals with reactors.

The first five chapters of the volume deal with research reactors while the remaining six chapters deal with power and production reactors. The research reactors are dealt with on a territorial basis, each of the chapters describing the reactors in Canada, U.S., U.S.S.R., the European Continent (France, Norway and Sweden) and the U.K.

The research reactors recently built or under construction are mostly of three types. Firstly we have the enriched U-ordinary water heterogeneous reactors of the M.T.R. and swimming pool type. These reactors have generally a small volume and a high power and flux density and are very useful in that they provide not only high thermal fluxes but also high fast fluxes, which are essential for radiation damage studies. There is a detailed description in the book of the design and construction of the M.T.R. and of the determinations of its various characteristics, and briefer descriptions of other reactors.

The other popular type of reactor is the heterogeneous heavy water one using mostly natural and sometimes enriched U. The European and Canadian reactors are all of this type and there are detailed descriptions in the book of the NRX in Canada and of the Chatillon and Saclay piles and of the many reactor physics experiments made with these. These types of reactors give high thermal fluxes and having fairly large volumes, are able to provide extensive experimental facilities. They are also very useful for testing out fuel assemblies and lattice designs for power reactors.

The third type of research reactors described are the homogeneous reactors in the U.S. using enriched U and ordinary or heavy water. These have many advantages but seem unable to give high fluxes.

The second half of the book is devoted entirely to a consideration of existing and proposed power and production reactors. The production part is important inasmuch as it appears that nuclear power will not be competitive with power from other sources unless the production of plutonium or  $U_{233}$  is taken into account. The power reactors in any country ultimately will not consist of a single type but of several types integrated for optimum power and production.

Britain and Russia seem to be interested in developing as soon as possible a reactor which would be able to produce large quantities of electrical power on a commercial scale. It is interesting that they have both pitched upon the graphite-U type as the one which promised quickest immediate development. There is a detailed description in the book of the Calder Hall reactors which have now come into operation. There is no description however of the Downreay fast reactor, which is the other type the British have decided to develop and only a very brief account of the Russian power reactor.

The rest of the book is devoted to a description of the proposed types of power reactors in the United States. The differences between the types lie mainly in the different ways of extracting and utilising the heat produced in the reactor. In the P.W.R. which is described in great detail, the heat transfer is made with pressurised water which attains a high temperature in the reactor without boiling, while in the boiling water reactor, steam is generated in the reactor itself. The P.W.R. is also interesting in that it employs a type of reactor with highly enriched U seeds in natural U assembly. In homogeneous reactors, the whole solution or slurry is circulated. There is a detailed description of the sodium-cooled graphite reactor. There is a discussion of fast reactors without a description of any actual reactor. The possibility of fast power reactors depends largely on high heat transfer performance which is just possible with liquid sodium coolant.

There is a very useful catalogue at the end of all reactors existing, dismantled, building or proposed. There is an interesting foreword by Sir Christopher Hinton.

S. B. D. IYENGAR.

\* Edited by R. A. Charpie, D. J. Littler, D. J. Hughes, and M. Trocheris. (Pergamon Press, New York), 1956. Pp. x + 492. Price 100 s/s.

## PROGRESS IN NUCLEAR ENERGY REACTORS\*

THE Geneva Conference on Atomic Energy resulted in the release of such a vast amount of information, that many attempts have been made to present this information in a compact and easily accessible form. The 'Progress in Nuclear Energy' Series does this in eight volumes, and the present volume is the second of the series and deals with reactors.

The first five chapters of the volume deal with research reactors while the remaining six chapters deal with power and production reactors. The research reactors are dealt with on a territorial basis, each of the chapters describing the reactors in Canada, U.S., U.S.S.R., the European Continent (France, Norway and Sweden) and the U.K.

The research reactors recently built or under construction are mostly of three types. Firstly we have the enriched U-ordinary water heterogeneous reactors of the M.T.R. and swimming pool type. These reactors have generally a small volume and a high power and flux density and are very useful in that they provide not only high thermal fluxes but also high fast fluxes, which are essential for radiation damage studies. There is a detailed description in the book of the design and construction of the M.T.R. and of the determinations of its various characteristics, and briefer descriptions of other reactors.

The other popular type of reactor is the heterogeneous heavy water one using mostly natural and sometimes enriched U. The European and Canadian reactors are all of this type and there are detailed descriptions in the book of the NRX in Canada and of the Chatillon and Saclay piles and of the many reactor physics experiments made with these. These types of reactors give high thermal fluxes and having fairly large volumes, are able to provide extensive experimental facilities. They are also very useful for testing out fuel assemblies and lattice designs for power reactors.

The third type of research reactors described are the homogeneous reactors in the U.S. using enriched U and ordinary or heavy water. These have many advantages but seem unable to give high fluxes.

The second half of the book is devoted entirely to a consideration of existing and proposed power and production reactors. The production part is important inasmuch as it appears that nuclear power will not be competitive with power from other sources unless the production of plutonium or  $U_{233}$  is taken into account. The power reactors in any country ultimately will not consist of a single type but of several types integrated for optimum power and production.

Britain and Russia seem to be interested in developing as soon as possible a reactor which would be able to produce large quantities of electrical power on a commercial scale. It is interesting that they have both pitched upon the graphite-U type as the one which promised quickest immediate development. There is a detailed description in the book of the Calder Hall reactors which have now come into operation. There is no description however of the Downreay fast reactor, which is the other type the British have decided to develop and only a very brief account of the Russian power reactor.

The rest of the book is devoted to a description of the proposed types of power reactors in the United States. The differences between the types lie mainly in the different ways of extracting and utilising the heat produced in the reactor. In the P.W.R. which is described in great detail, the heat transfer is made with pressurised water which attains a high temperature in the reactor without boiling, while in the boiling water reactor, steam is generated in the reactor itself. The P.W.R. is also interesting in that it employs a type of reactor with highly enriched U seeds in natural U assembly. In homogeneous reactors, the whole solution or slurry is circulated. There is a detailed description of the sodium-cooled graphite reactor. There is a discussion of fast reactors without a description of any actual reactor. The possibility of fast power reactors depends largely on high heat transfer performance which is just possible with liquid sodium coolant.

There is a very useful catalogue at the end of all reactors existing, dismantled, building or proposed. There is an interesting foreword by Sir Christopher Hinton.

S. B. D. IYENGAR.

\* Edited by R. A. Charpie, D. J. Littler, D. J. Hughes, and M. Trocheris. (Pergamon Press, New York), 1956. Pp. x + 492. Price 100 s/z.

## SCIENCE NOTES AND NEWS

*Alternaria zinnæ* Pape. in India

*Alternaria elegans*, a common ornamental plant in Delhi gardens, has been found to be badly damaged by fungus which has been identified as *Alternaria zinnæ* Pape. Messrs. B. L. Chona and J. N. Kapoor, Division of Mycology and Plant Pathology, I.A.R.I., New Delhi, report for the first time from Northern India.

### Isolation of Plutonium

In a recent speech, Willard F. Libby, Commissioner, Atomic Energy Commission, U.S.A., urged chemists to learn a way of adapting the isolation of plutonium in atomic weapons for peaceful power. He challenged scientists to discover a way to "burn up" plutonium for fuel, should the time come when the weapons stockpile is considered large enough.

The fact that plutonium is highly dangerous has so far hindered its use in power development. Plutonium, like radiostrontium, emits alpha rays and accumulates in human bone. The need for increased safety precautions has so far made plutonium less attractive to experiment with than enriched uranium-235, the current source of power fuel.

### Aluminium with the Hardness of Steel

A new method of electrolysis, known as hard anode treatment, has been elaborated by Professor N. D. Tomashev and M. N. Tyunin at the Institute of Physical Chemistry of the USSR Academy of Sciences, which makes it possible to obtain an oxide layer of extreme hardness, firmly bound with the basic metal, on the surface of aluminium and its alloys. The thickness of this layer may be 100-150 microns and more, this being several times the hardness obtained by previous methods. The anode film obtained by this method considerably increases the resistance of aluminium to wear and friction. Furthermore, it increases the surface heat-resistance and electric insulating properties, capable of standing a temperature of 2,000 volts.

### Rocket Flight Around the Moon

Professor Chebotarev, of the Institute of Theoretical Astronomy of the USSR Academy of Sciences, has established the theoretical possibility of sending up a rocket for a flight

around the moon and the return to earth, carrying a smaller amount of fuel than has hitherto been considered necessary. Professor Chebotarev's calculations have shown that the rocket only needs fuel during the first period of its flight, after which it will continue to move under the influence of the gravity of the moon, sun and earth.

According to these computations, the rocket will travel a maximum distance of 400,000 km. from the earth. The distance between the earth and the moon is 384,000 km. The velocity of the rocket will drop from 11 km. per second at the start to nought as it approaches the moon. Thanks to this, the rocket will fly round the moon, thus making it possible to observe that planet from the side not visible from the earth. The entire flight will take 10 days and nights.

### Genetics Congress Resolution on Radiation Hazards

At the final session of the International Congress of Human Genetics which met recently in Copenhagen, Denmark, Herman J. Muller, of the University of Indiana, proposed the following resolution on radiation danger. It was passed unanimously by the approximately 400 participants.

"The damage produced by radiation on the hereditary material (of man) is real and should be taken seriously into consideration in both the peaceful and military uses of nuclear energy as well as in all medical, commercial and industrial practices in which X-rays or other ionizing radiation is emitted.

"It is recommended that the investigation of the amount and type of damage and of related genetic questions be greatly extended and intensified with a view of safeguarding the well-being of future generations."

### Scientific Aid to Fishing

The latest addition to the fisherman's scientific armoury, the Kelvin Hughes Fisherman's Asdic, will be on the world's markets about the middle of next year. It is a new application of the technique of transmitting acoustic pulses which rebound from solid bodies and are recorded back in the boat. An expert operator can interpret from the blips and smudges not only that he is passing over a shoal, but

## PROGRESS IN NUCLEAR ENERGY REACTORS\*

THE Geneva Conference on Atomic Energy resulted in the release of such a vast amount of information, that many attempts have been made to present this information in a compact and easily accessible form. The 'Progress in Nuclear Energy' Series does this in eight volumes, and the present volume is the second of the series and deals with reactors.

The first five chapters of the volume deal with research reactors while the remaining six chapters deal with power and production reactors. The research reactors are dealt with on a territorial basis, each of the chapters describing the reactors in Canada, U.S., U.S.S.R., the European Continent (France, Norway and Sweden) and the U.K.

The research reactors recently built or under construction are mostly of three types. Firstly we have the enriched U-ordinary water heterogeneous reactors of the M.T.R. and swimming pool type. These reactors have generally a small volume and a high power and flux density and are very useful in that they provide not only high thermal fluxes but also high fast fluxes, which are essential for radiation damage studies. There is a detailed description in the book of the design and construction of the M.T.R. and of the determinations of its various characteristics, and briefer descriptions of other reactors.

The other popular type of reactor is the heterogeneous heavy water one using mostly natural and sometimes enriched U. The European and Canadian reactors are all of this type and there are detailed descriptions in the book of the NRX in Canada and of the Chatillon and Saclay piles and of the many reactor physics experiments made with these. These types of reactors give high thermal fluxes and having fairly large volumes, are able to provide extensive experimental facilities. They are also very useful for testing out fuel assemblies and lattice designs for power reactors.

The third type of research reactors described are the homogeneous reactors in the U.S. using enriched U and ordinary or heavy water. These have many advantages but seem unable to give high fluxes.

The second half of the book is devoted entirely to a consideration of existing and proposed power and production reactors. The production part is important inasmuch as it appears that nuclear power will not be competitive with power from other sources unless the production of plutonium or  $U_{233}$  is taken into account. The power reactors in any country ultimately will not consist of a single type but of several types integrated for optimum power and production.

Britain and Russia seem to be interested in developing as soon as possible a reactor which would be able to produce large quantities of electrical power on a commercial scale. It is interesting that they have both pitched upon the graphite-U type as the one which promised quickest immediate development. There is a detailed description in the book of the Calder Hall reactors which have now come into operation. There is no description however of the Downreay fast reactor, which is the other type the British have decided to develop and only a very brief account of the Russian power reactor.

The rest of the book is devoted to a description of the proposed types of power reactors in the United States. The differences between the types lie mainly in the different ways of extracting and utilising the heat produced in the reactor. In the P.W.R. which is described in great detail, the heat transfer is made with pressurised water which attains a high temperature in the reactor without boiling, while in the boiling water reactor, steam is generated in the reactor itself. The P.W.R. is also interesting in that it employs a type of reactor with highly enriched U seeds in natural U assembly. In homogeneous reactors, the whole solution or slurry is circulated. There is a detailed description of the sodium-cooled graphite reactor. There is a discussion of fast reactors without a description of any actual reactor. The possibility of fast power reactors depends largely on high heat transfer performance which is just possible with liquid sodium coolant.

There is a very useful catalogue at the end of all reactors existing, dismantled, building or proposed. There is an interesting foreword by Sir Christopher Hinton.

S. B. D. IYENGAR.

\* Edited by R. A. Charpie, D. J. Littler, D. J. Hughes, and M. Trocheris. (Pergamon Press, New York), 1956. Pp. x + 492. Price 100 s/z.

## SCIENCE NOTES AND NEWS

*aria zinnæ* Pape. in India

*ia elegans*, a common ornamental plant in gardens, has been found to be badly affected by fungus which has been identified as *arnaria zinnæ* Pape. Messrs. B. L. Chona N. Kapoor, Division of Mycology and Pathology, I.A.R.I., New Delhi, report for the first time from Northern India.

### tion of Plutonium

In a recent speech, Willard F. Libby, Comptroller, Atomic Energy Commission, U.S.A., urged chemists to learn a way of adapting the plutonium in atomic weapons for peaceful power. He challenged scientists to discover a way to "burn up" plutonium for fuel, should the time come when the weapons stockpile is considerable enough.

The fact that plutonium is highly dangerous has so far hindered its use in power development. Plutonium, like radiostrontium, emits alpha rays and accumulates in human bone. The need for increased safety precautions has so far made plutonium less attractive to experiment with than enriched uranium-235, the current source of power fuel.

### ium with the Hardness of Steel

A new method of electrolysis, known as hard anode treatment, has been elaborated by Professor N. D. Tomashev and M. N. Tyutunov at the Institute of Physical Chemistry of the USSR Academy of Sciences, which makes it possible to obtain an oxide layer of extreme thickness, firmly bound with the basic metal, on the surface of aluminium and its alloys. The thickness of this layer may be 100-150 microns and more, this being several times the thickness obtained by previous methods. The anode film obtained by this method considerably increases the resistance of aluminium to wear and friction. Furthermore, it increases the surface heat-resistance and electric insulating properties, capable of standing a temperature of 2,000 volts.

### Flight Around the Moon

Professor Chebotarev, of the Institute of Physical Astronomy of the USSR Academy of Sciences, has established the theoretical possibility of sending up a rocket for a flight

around the moon and the return to earth, carrying a smaller amount of fuel than has hitherto been considered necessary. Professor Chebotarev's calculations have shown that the rocket only needs fuel during the first period of its flight, after which it will continue to move under the influence of the gravity of the moon, sun and earth.

According to these computations, the rocket will travel a maximum distance of 400,000 km. from the earth. The distance between the earth and the moon is 384,000 km. The velocity of the rocket will drop from 11 km. per second at the start to nought as it approaches the moon. Thanks to this, the rocket will fly round the moon, thus making it possible to observe that planet from the side not visible from the earth. The entire flight will take 10 days and nights.

### Genetics Congress Resolution on Radiation Hazards

At the final session of the International Congress of Human Genetics which met recently in Copenhagen, Denmark, Herman J. Muller, of the University of Indiana, proposed the following resolution on radiation danger. It was passed unanimously by the approximately 400 participants.

"The damage produced by radiation on the hereditary material (of man) is real and should be taken seriously into consideration in both the peaceful and military uses of nuclear energy as well as in all medical, commercial and industrial practices in which X-rays or other ionizing radiation is emitted.

"It is recommended that the investigation of the amount and type of damage and of related genetic questions be greatly extended and intensified with a view of safeguarding the well-being of future generations."

### Scientific Aid to Fishing

The latest addition to the fisherman's scientific armoury, the Kelvin Hughes Fisherman's Asdic, will be on the world's markets about the middle of next year. It is a new application of the technique of transmitting acoustic pulses which rebound from solid bodies and are recorded back in the boat. An expert operator can interpret from the blips and smudges not only that he is passing over a shoal, but



## PROGRESS IN NUCLEAR ENERGY REACTORS\*

THE Geneva Conference on Atomic Energy resulted in the release of such a vast amount of information, that many attempts have been made to present this information in a compact and easily accessible form. The 'Progress in Nuclear Energy' Series does this in eight volumes, and the present volume is the second of the series and deals with reactors.

The first five chapters of the volume deal with research reactors while the remaining six chapters deal with power and production reactors. The research reactors are dealt with on a territorial basis, each of the chapters describing the reactors in Canada, U.S., U.S.S.R., the European Continent (France, Norway and Sweden) and the U.K.

The research reactors recently built or under construction are mostly of three types. Firstly we have the enriched U-ordinary water heterogeneous reactors of the M.T.R. and swimming pool type. These reactors have generally a small volume and a high power and flux density and are very useful in that they provide not only high thermal fluxes but also high fast fluxes, which are essential for radiation damage studies. There is a detailed description in the book of the design and construction of the M.T.R. and of the determinations of its various characteristics, and briefer descriptions of other reactors.

The other popular type of reactor is the heterogeneous heavy water one using mostly natural and sometimes enriched U. The European and Canadian reactors are all of this type and there are detailed descriptions in the book of the NRX in Canada and of the Chatillon and Saclay piles and of the many reactor physics experiments made with these. These types of reactors give high thermal fluxes and having fairly large volumes, are able to provide extensive experimental facilities. They are also very useful for testing out fuel assemblies and lattice designs for power reactors.

The third type of research reactors described are the homogeneous reactors in the U.S. using enriched U and ordinary or heavy water. These have many advantages but seem unable to give high fluxes.

The second half of the book is devoted entirely to a consideration of existing and proposed power and production reactors. The production part is important inasmuch as it appears that nuclear power will not be competitive with power from other sources unless the production of plutonium or  $U_{233}$  is taken into account. The power reactors in any country ultimately will not consist of a single type but of several types integrated for optimum power and production.

Britain and Russia seem to be interested in developing as soon as possible a reactor which would be able to produce large quantities of electrical power on a commercial scale. It is interesting that they have both pitched upon the graphite-U type as the one which promised quickest immediate development. There is a detailed description in the book of the Calder Hall reactors which have now come into operation. There is no description however of the Downreay fast reactor, which is the other type the British have decided to develop and only a very brief account of the Russian power reactor.

The rest of the book is devoted to a description of the proposed types of power reactors in the United States. The differences between the types lie mainly in the different ways of extracting and utilising the heat produced in the reactor. In the P.W.R. which is described in great detail, the heat transfer is made with pressurised water which attains a high temperature in the reactor without boiling, while in the boiling water reactor, steam is generated in the reactor itself. The P.W.R. is also interesting in that it employs a type of reactor with highly enriched U seeds in natural U assembly. In homogeneous reactors, the whole solution or slurry is circulated. There is a detailed description of the sodium-cooled graphite reactor. There is a discussion of fast reactors without a description of any actual reactor. The possibility of fast power reactors depends largely on high heat transfer performance which is just possible with liquid sodium coolant.

There is a very useful catalogue at the end of all reactors existing, dismantled, building or proposed. There is an interesting foreword by Sir Christopher Hinton.

S. B. D. IYENGAR.

\* Edited by R. A. Charpie, D. J. Littler, D. J. Hughes, and M. Trocheris. (Pergamon Press, New York), 1956. Pp. x + 492. Price 100 s/s.

## SCIENCE NOTES AND NEWS

### *Alternaria zinnæ* Pape. in India

*Zinnia elegans*, a common ornamental plant in Delhi gardens, has been found to be badly damaged by fungus which has been identified as *Alternaria zinnæ* Pape. Messrs. B. L. Chona and J. N. Kapoor, Division of Mycology and Plant Pathology, I.A.R.I., New Delhi, report this for the first time from Northern India.

### Utilisation of Plutonium

In a recent speech, Willard F. Libby, Commissioner, Atomic Energy Commission, U.S.A., urged chemists to learn a way of adapting the plutonium in atomic weapons for peaceful power uses. He challenged scientists to discover a way to "burn up" plutonium for fuel, should the day come when the weapons stockpile is considered large enough.

The fact that plutonium is highly dangerous has so far hindered its use in power development. Plutonium, like radiostrontium, emits alpha rays and accumulates in human bone. The need for increased safety precautions has so far made plutonium less attractive to experiment with than enriched uranium-235, the current source of power fuel.

### Aluminium with the Hardness of Steel

A new method of electrolysis, known as hard or deep anode treatment, has been elaborated by Professor N. D. Tomashev and M. N. Tyukina, at the Institute of Physical Chemistry of the USSR Academy of Sciences, which makes it possible to obtain an oxide layer of extreme hardness, firmly bound with the basic metal, on the surface of aluminium and its alloys. The thickness of this layer may be 100-150 microns and more, this being several times the thickness obtained by previous methods. The thick anode film obtained by this method considerably increases the resistance of aluminium alloys to wear and friction. Furthermore, it lends the surface heat-resistance and electric insulating properties, capable of standing a tension of 2,000 volts.

### Rocket Flight Around the Moon

Professor Chebotarev, of the Institute of Theoretical Astronomy of the USSR Academy of Sciences, has established the theoretical possibility of sending up a rocket for a flight

around the moon and the return to earth, carrying a smaller amount of fuel than has hitherto been considered necessary. Professor Chebotarev's calculations have shown that the rocket only needs fuel during the first period of its flight, after which it will continue to move under the influence of the gravity of the moon, sun and earth.

According to these computations, the rocket will travel a maximum distance of 400,000 km. from the earth. The distance between the earth and the moon is 384,000 km. The velocity of the rocket will drop from 11 km. per second at the start to nought as it approaches the moon. Thanks to this, the rocket will fly round the moon, thus making it possible to observe that planet from the side not visible from the earth. The entire flight will take 10 days and nights.

### Genetics Congress Resolution on Radiation Hazards

At the final session of the International Congress of Human Genetics which met recently in Copenhagen, Denmark, Herman J. Muller, of the University of Indiana, proposed the following resolution on radiation danger. It was passed unanimously by the approximately 400 participants.

"The damage produced by radiation on the hereditary material (of man) is real and should be taken seriously into consideration in both the peaceful and military uses of nuclear energy as well as in all medical, commercial and industrial practices in which X-rays or other ionizing radiation is emitted.

"It is recommended that the investigation of the amount and type of damage and of related genetic questions be greatly extended and intensified with a view of safeguarding the well-being of future generations."

### Scientific Aid to Fishing

The latest addition to the fisherman's scientific armoury, the Kelvin Hughes Fisherman's Asdic, will be on the world's markets about the middle of next year. It is a new application of the technique of transmitting acoustic pulses which rebound from solid bodies and are recorded back in the boat. An expert operator can interpret from the blips and smudges not only that he is passing over a shoal, but

terms of P, V and T from (1) and (2) in equation (3), we have

$$\frac{PV}{\beta} = F\left(\frac{T}{\beta}\right) \quad (5)$$

or

$$PV = \beta F\left(\frac{T}{\beta}\right) \quad (6)$$

Comparing this with (4) we obtain

$$F(T) = \beta F\left(\frac{T}{\beta}\right) \quad (7)$$

The unique solution of this functional equation is known to be  $F(T) = \alpha T$ , where  $\alpha$  is a constant. Hence we have  $PV = \alpha T$ , i.e., the product PV must be a linear function of the temperature in all systems.

Dept. of Physics, MOHD. SAMIULLAH.  
Mahboob College,  
Secunderabad, July 25, 1956.

1. Tolman, R. C., *Relativity, Thermodynamics and Cosmology*, Oxford, 1934, pp. 158-59.

### FORCE CONSTANTS OF SOME RADICALS OF $XY_6$ TYPE

THE Wilson's<sup>1</sup> F-G matrix method of analysis of molecular vibrations has been applied to the evaluation of the force constants of some radicals of  $XY_6$  type, from their Raman frequencies. The radicals discussed here have the octahedral symmetry  $O_h$  and give rise to three vibrations active in Raman effect. Of these, one is total symmetric ( $a_{1g}$ ), one is doubly degenerate ( $e_g$ ) and the third one is triply degenerate ( $f_{2g}$ ).

The potential function used in this investigation consists of four force constants  $f_d$ ,  $f_a$ ,  $f_{dd}$  and  $f_{aa}$  which have got the usual significance. The interaction force constant  $f_{da}$  has not been taken into consideration as the secular equations corresponding to the observed three frequencies do not contain  $f_{da}$ . The observed Raman frequencies in the case of the radicals discussed here and the force constants obtained from them are given in Table I.

TABLE I

Radical	Observed frequencies cm. <sup>-1</sup>			Force constants (10 <sup>5</sup> dyne cm. <sup>-1</sup> )			$\lambda$ in Å Badger's rule <sup>2</sup>
	$a_{1g}$	$e_g$	$f_{2g}$	$f_d$	$f_{dd}$	$f_a - 2f_{aa}$	
SiF <sub>6</sub> <sup>2</sup>	646	466	403	1.902	0.237	0.901	1.61
SeCl <sub>6</sub> <sup>3</sup>	346	273	166	1.294	0.109	0.288	..
SnCl <sub>6</sub> <sup>3</sup>	320	235	158	1.143	0.127	0.261	2.52
SnBr <sub>6</sub> <sup>3</sup>	183	144	69	0.704	0.060	0.112	..
SbCl <sub>6</sub> <sup>3</sup>	337	277	172	1.640	0.199	0.310	2.80

Dept. of Physics, K. VENKATESWARLU.  
Annamalai University, S. SUNDARAM.  
Annamalainagar, August 6, 1956.

1. Wilson, E. B. Jr., *J. Chem. Phys.*, 1939, 7, 1047; 1941, 9, 76.
2. Couture-Mathieu, L. and Mathieu, J. P., *J. Phys. Radium*, 1951, 12, 826.
3. Landolt-Bornstein, *Atom-und Molecular Physik*, Springer-Verlag, Berlin, 1951, 280.
4. Badger, R. M., *J. Chem. Phys.*, 1935, 3, 710.

### ACTION OF TARTARIC ACID ON BRASS

DURING studies on corrosion in brass, a specimen of alpha brass (composition 67.3% Cu, 32.7% Zn) was exposed in a beaker containing 230 ml. of N/1000 tartaric acid solution, and it was found that after three days, a photographic impression of the patent mark on the beaker was formed on the surface of the brass plate (Fig. 1).

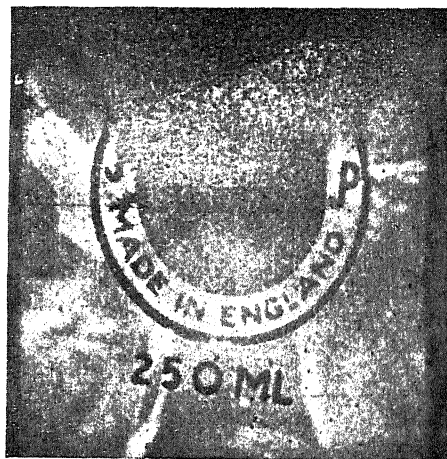


FIG. 1.

Specimens of area 6 cm. × 3 cm. cut accurately were used. Glass hooks were employed for suspension. A specimen piece of the alloy was first washed with distilled-water several times and then dried. It was then polished using successively 0 to 0000 Oakeys' emery papers. A mirror-like finish was obtained by polishing with jeweller's rouge.<sup>1</sup> The specimen was finally degreased by carbon tetrachloride. Tartaric acid of A.R. grade was used and the experiment was carried out at 33° C. After exposure, the specimen was cleaned with distilled-water, dried, weighed and photographed. To find out the loss on corrosion, the exposed plate was subsequently treated in a fresh beaker with 5% sulphuric acid.<sup>2</sup>

Experiments were performed with tartaric acid of various concentrations, from 0.001 N to 1.0 N. Only in 0.001 N was the formation of a photosensitive film noticed. In all other cases direct dissolution apparently takes place.

The film shows yellow, brown and bluish green colours. On testing with dilute sulphuric acid the film was blackened; dilute hydrochloric acid removed the film and there was a slight blackening at the sites of the film formation. Dilute ammonia had no effect. When a copper plate was similarly exposed a very faint image was obtained after three days.

Our thanks are due to Ahmedabad Education Society for laboratory facilities and the Gujarat University for the grant of a research scholarship to one of us (M. N. D.).

L. D. Arts College and A. K. M. TRIVEDI,  
M. G. Science Institute, M. N. DESAI,  
Ahmedabad-9,  
September 15, 1956.

1. Shaw, L. B. and Evelyn, M. H., *J.C.S.*, 1942, 599.
2. Wiedemann, W., *Kleinvergnügendes*, 1945, Berlin, Verlag Chemie.

### USE OF A COARSE GRATING TO FIND THE WAVELENGTH OF HIGH FREQUENCY SOUND WAVES IN A LIQUID

DIFFRACTION of light by high frequency sound waves traversing a liquid in an optical cell mounted on the table of a spectrometer, is utilised for finding the wavelength of sound waves  $\lambda$  in the liquid. The angles of diffraction of successive orders differ by  $\theta$  which is of the order of  $12'$  or less and an error of 10% is inevitable in the determination of that angle directly by means of a spectrometer, telescope and scale.

Considerable accuracy is obtainable, if a plane transmission coarse grating of accurately known spacing  $D$  is also employed in combination with the acoustic grating. Diffraction orders of both gratings are then seen when observed through the telescope of the spectrometer, on which the gratings are mounted, the acoustic grating on an independent platform and the other on the spectrometer table proper. Turning the table, say clockwise, the coarse grating is set at such an oblique angle of incidence  $i$  that the apparent spacing of the diffracted orders of the coarse grating becomes equal to that of the other, when exact coincidence between the two sets of different orders take place. Similar coincidence is ob-

tained in another position when the table is turned in the opposite direction. The angle between the two positions is  $2i$  which may be made to be of the order of  $60'$  to  $90'$ , when a proper value for  $D$  is chosen. The variation  $\delta i$  in the value of  $i$  for different measurements is not more than  $\frac{1}{2}''$ .

In this case the wavelength of sound waves is given by  $\lambda = D \cos i$  and the error in its determination is  $\Delta = \Delta i \tan i$  which is only about 0.5% when  $i$  is  $30'$  and  $\delta i$  is  $\frac{1}{2}''$ .

The author measured the wavelength of high frequency (7.5 Mc/s.) sound waves in water at  $30'$  using a coarse grating  $D = 0.05$  cm., accurately ruled on silvered glass. The various values of  $2i$  when the second diffracted order of the coarse grating coincided with the first diffracted order of the acoustic grating, did not differ by even  $1'$  and the average value was  $73' 28''$  which yielded a value of  $\lambda = \frac{1}{2} D \cos i = 0.02004$  cm. for the wavelength of the sound waves in water. The velocity of the waves was found to be 1503 metres per second. Details of this work are being published elsewhere.

GOPALA MENON, SREEKANTATH.

University College,  
Travancore University,  
Trivandrum, September 25, 1956.

### INFRARED SPECTRUM OF ORTHO-FLUOROBROMOBENZENE

IN continuation of the work on the ultra-violet absorption<sup>1</sup> and Raman effect<sup>2</sup> of ortho-fluorobromobenzene, the infrared spectrum of this compound has been studied. There is no previous report on the infrared spectrum of this molecule.

The spectrum is obtained with a Leitz infrared prism spectrograph equipped with Rock salt and potassium bromide optics. The liquid absorption spectrum in the Rock salt region is reported in the present communication. The spectrum is reproduced in Fig. 1.

About 90 bands are recorded and almost all of them are interpreted in terms of the fundamental frequencies shown in Table I. These fundamentals agree well with the Raman frequencies reported earlier.<sup>2</sup> The fundamentals marked with asterisks occur more frequently in the combination bands. The classification of the vibrations into planar  $\alpha'$  vibrations and non-planar  $\alpha''$  vibrations is partly aided by the state of polarisation of the corresponding Raman lines and the relative intensities in the infrared and Raman effect and by the magnitude of

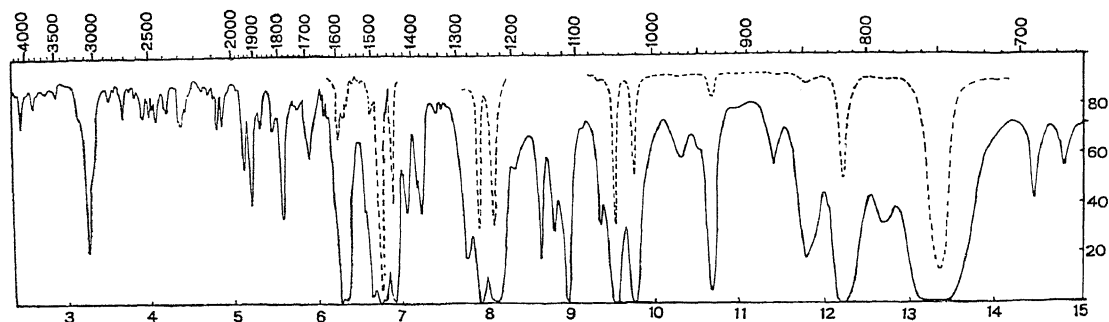


FIG. 1. Infrared spectrum of liquid ortho-fluorobromobenzene. (Solid curve—film thickness 0.09 mm.; dotted curve—capillary film.)

the frequencies compared to those of the ortho-fluorochlorobenzene (Nielsen).<sup>3</sup>

The author is grateful to Dr. G. C. Finger of the Illinois State Geological Survey for the gift of the sample. The author is deeply indebted to Prof. K. R. Rao for valuable guidance.

TABLE I

$\nu$	Int.	Species	$\nu$	Int.	Species
694	mw	$a''$	*1235	s	$a'$
*750	vvs	$a''$	1263	s	$a'$
790	m	$a''$	1287	ms	$a'$
*820	vs	$a''$	*1448	s	$a'$
*849	ms	$a''$	*1480	vs	$a'$
*939	s	$a''$	*1580	ms	$a'$
*1026	vs	$a'$	1592	s	$a'$
1050	vs	$a'$	3012	m	$a'$
*1117	s	$a'$	3054	ms	$a'$
*1158	ms	$a'$	3158	w	$a'$

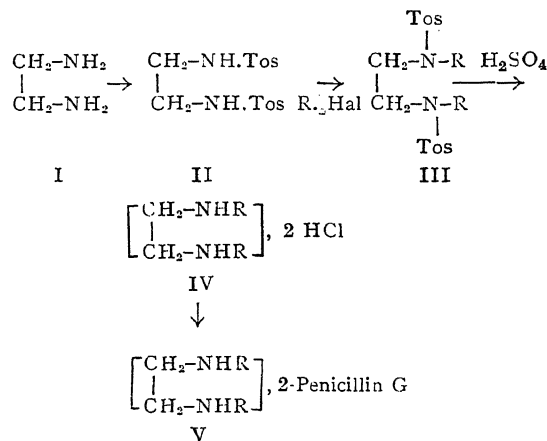
S. L. N. G. KRISHNAMACHARI.

Physics Department,  
Andhra University,  
Waltair, October 5, 1956.

1. Krishnamachari, S. L. N. G., *Ind. Jour. Phys.*, 1956, 30, 487.
2. —, *Curr. Sci.*, 1956, 25, 185.
3. Nielsen, J. R. and others, *Jour. Chem. Phys.*, 1956, 24, 433.

### N:N'-DIALKYLETHYLENE DIAMINE SALTS OF PENICILLIN G

A SYSTEMATIC work has been undertaken to discover repository salts of penicillin which could give blood concentrations of the order of about 0.5 units per ml. for about a week after single injection.<sup>1</sup> In the course of this work a series of N:N'-dialkylethylene diamines (IV) and their dipenicillin salts (V) have been prepared as follows:



No.	R	N-N'-Di- <i>p</i> -toluene sulphonyl derivative M.P. (III)	N-N'-Dialkyl E.D. Di-hydrochloride M.P. (IV)	Dipenicillin G Salt M.P. (V)
1	Methyl	163-64°	232-34°	132°
2	Ethyl	168	260	104-06
3	N-propyl	120-21	295	92
4	N-butyl	119	295-300	111-12
5	N-amyl	116-17	305-10	102-04
6	<i>Is</i> o-amyl	119-21	293	108
7	N-hexyl	115-16	284-86	89
8	N-heptyl	112	292-93	98
9	N-octyl	82-83	275-78	93
10	N-lauryl	65-66	252-55	76-78

The condensation of ethylene diamine (I) with the alkyl halides gave a mixture of various substituted products. So the diamines (IV) were prepared *via* the toluene sulphonyl derivative (II)<sup>2</sup> which was alkylated with alkyl halide (R hal.) in presence of potassium hydroxide (10%) in ethylene glycol-alcohol mixture at 140° C., the condensed product (III) hydrolysed with sulphuric acid (conc.) and the amines (IV) isolated as the hydrochloride.<sup>3</sup> In the case of compounds

Nos. 4 to 7, the penicillin salts were prepared by treating the aqueous solution of hydrochloride with aqueous solution of potassium penicillin G and in the case of compounds Nos. 1 to 3 and 8 to 10 by treating the penicillin acid in dry ether with the amine in the same solvent. The yields in all the above steps are quantitative.

The study of their properties like solubility, stability, blood levels and toxicity, etc., is under progress and the details will be published in due course.

Our thanks are due to Dr. K. Ganapathi and Dr. R. Kanchal for the keen interest in the work.

Antibiotic Res. Centre, G. N. VYAS,  
Hindustan Antibiotics, S. G. DHOPATE,  
(Private), Ltd.,  
Pimpri, Bombay State,  
October 11, 1956.

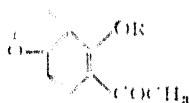
1. Vyas, G. N. and Dhopate, S. G., *Symposium on Antibiotics*, March 1956 (Council of Scientific and Industrial Research publication).
2. Armstrong, L. H. and Tomley, R. L., *J. Amer. Chem. Soc.*, 1940, **62**, 2812.
3. Fieser, W. R., *J. Chem. Soc.*, 1947, 311.

### SOME REACTIONS OF PONGAMOL

Hydrolysis of pongamol with absolute alcoholic potash has yielded 5-acetyl-4-hydroxy-benzofuran, m.p. 86° C. (purification by vacuum sublimation) besides 5-acetyl-4-methoxy-benzofuran already isolated<sup>1</sup> by Narayanaswamy *et al.*

Demethylation of 5-acetyl-4-methoxy-benzofuran (I), using hydriodic acid in acetic anhydride solution gave only poor yields of 5-acetyl-4-hydroxy-benzofuran (II), identical with the sample isolated during the alcoholic potash fission. (Found: C, 68.17; H, 4.56;  $C_{10}H_8O_3$  requires C, 68.16 and H, 4.54%.)

The structure of 5-acetyl-4-hydroxy-benzofuran (II) has been established by an independent synthesis. O-acetyl karanjie acid<sup>2</sup> was first converted into the acid chloride using thionyl chloride and then condensed with excess diazomethane to give the diazoketone which was subsequently reduced using hydriodic acid in chloroform solution as described earlier,<sup>3</sup> followed by hydrolysis to give 5-acetyl-4-hydroxy-benzofuran (II) in good yield.



(I, R = CH<sub>3</sub>)  
(II, R = H)

5-Acetyl-4-methoxy-benzofuran was similarly obtained starting from O-methyl-karanjie acid.

Dept. of Chemistry, Ch. BHEEMASANKARA RAO,  
Andhra University, V. VENKATESWARLU,  
Waltair, July 14, 1956.

1. Narayanaswamy, S., Rangaswamy, S. and Seshadri, T. R., *J.C.S.*, 1954, 1871.
2. Seshadri, T. R. and Venkateswarlu, V., *Proc. Ind. Acad. Sci.*, 1941, **13A**, 404.
3. Venkateswarlu, V., *Curr. Sci.*, 1955, **25**, 155.

### RAUVOLFIA ALKALOIDS IN AVIAN MALARIA (*P. GALLINACEUM*)

BESIDES their well established therapeutic uses in hyperpiesia and psychiatric conditions, the Rauvolfia alkaloids are considered to be of value by practitioners of indigenous medicine, in clinical disorders like diarrhoea, dysenteries and fevers associated with rigors. A partial explanation for their empirical use lies in the antibacterial activity exhibited by the crude total alkaloids (CTA) on *Micrococcus pyogenes* and *Shigella sonnei*. Since many of the fevers associated with rigors are malarial in origin, the effect of these alkaloids on experimental malaria has been investigated.

The effects of crude total alkaloids obtained by methods previously described<sup>1</sup> and of reserpine were both studied.

*P. gallinaceum* infections in chicken have been reported to be sensitive to all drugs so far discovered to be active in human malaria<sup>2</sup> and hence the screening of these alkaloids has been carried out on this species.

The evaluation, as carried out by standard technique<sup>3</sup> has shown that the oral administration of crude total alkaloids and reserpine in doses of 200 mg./100 g. and 20 mg./100 g. body weight respectively, did not exhibit any suppressive activity or lessening of the severity of the infection, thus indicating the clinical inefficiency of these alkaloids in avian malaria.

Pharmacology Lab., R. RAMA RAO,  
Indian Institute of Science, M. SIRSI,  
Bangalore-3, August 10, 1956.

1. Shaw, C. N. and Sirsi, M., *J. Mys. Med. Assn.*, 1955, **20** (1), 15.
2. Burn, J. H., Finney, D. J. and Goodwin, L. G., *Biological Standardisation*, 1950, Oxford Medical Publications, p. 412.
3. Rama Rao, R., Viswanathan, K. V., Ramaswamy, A. S. and Sirsi, M., *Curr. Sci.*, 1953, **22**, 305.

# A NEW METHOD FOR THE STRUCTURE ANALYSIS OF NON-CENTROSYMMETRIC CRYSTALS

G. N. RAMACHANDRAN AND S. RAMAN

Department of Physics, University of Madras, Guindy, Madras-25

NO direct methods are available at present for the determination of the phases of structure factors of a single non-centrosymmetric crystal. If two isomorphous crystals are available and if the positions of the replaceable atoms (A) in the unit cell can be fixed, then the phases of the various reflections can be determined but for an ambiguity between two possible values. This ambiguity is in the sign of the phase  $\theta$  with respect to the phase of the contribution from the replaceable atom, say,  $\alpha_A(hkl)$ , so that the phase of the structure factor  $F(hkl)$  may be either  $\alpha_1 = \alpha_A + \theta$  or  $\alpha_2 = \alpha_A - \theta$ . In all the determinations made so far, the replaceable atoms are related by a centre of inversion so that the phase  $\alpha_A(hkl)$  is either 0 or  $\pi$  and so  $\alpha_1 = -\alpha_2$ . In such a case, if a Fourier synthesis is calculated using both  $\alpha_1$  and  $\alpha_2$ , then the resulting diagram will consist of the structure, duplicated by its inverse at the inversion-centre of the replaceable atoms. If the replaceable atoms do not have a centre of symmetry, then no simple relation exists between the Fourier synthesis calculated by using both  $\alpha_1$  and  $\alpha_2$  and the actual structure.

## DETERMINATION OF PHASE FROM ANOMALOUS DISPERSION

It is possible to obtain the phases directly, without the need for an isomorphous pair of crystals by making use of effects of anomalous dispersion. Suppose the crystal contains one atom or a set of atoms, for which the imaginary component of the scattering factor is appreciable, while for all the other atoms, this component is negligible. Such a situation occurs in a large number of organic

compounds, containing a halogen or sulfur or a metal atom, in addition to C, N and O. In such a case, it is possible to find the phase  $\alpha(hkl)$  with reference to the phase  $\alpha_A$  of the anomalous scatterer.

Fig. 1 represents the various components of the structure amplitudes of a reflection and its inverse  $\bar{h}\bar{k}\bar{l}$ . The latter are indicated by a bar over the symbols.  $F_A'$  is that part of the contribution from the anomalous scatterer which depends upon normal dispersion

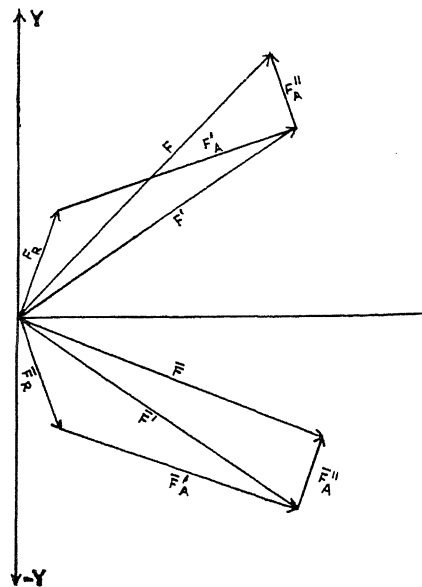
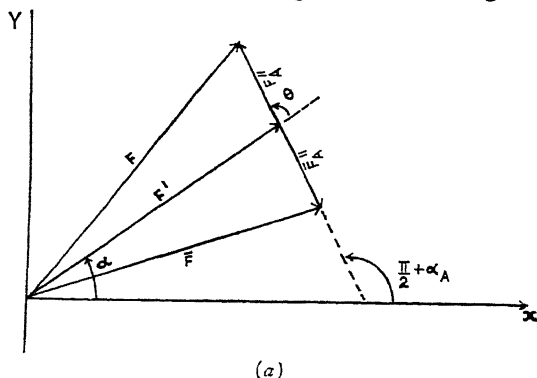
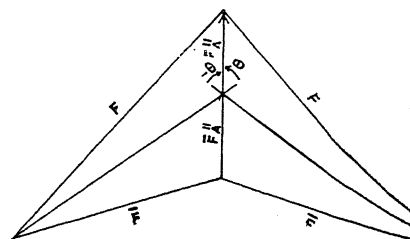


FIG. 1. Diagram showing the relationship between the various components of the structure amplitudes of a reflection and its inverse  $\bar{h}\bar{k}\bar{l}$ .

is the part which is produced by anomalous dispersion and  $F_R$  is the net contribution from all the other non-anomalous scatterers. The relationship between  $F$ ,  $F'$  and  $F_A''$  is clearly brought out in Fig. 2 where the



(a)



(b)

FIG. 2. Relation between  $F$ ,  $F'$  and  $F_A''$

relating to  $\bar{h}\bar{k}\bar{l}$  have been reflected about the real axis. We have from this diagram, since  $\bar{F}_A'' = F_A''$  numerically,

$$F^2 = F'^2 + F_A''^2 + 2 F' F_A'' \cos \theta$$

$$\bar{F}^2 = F'^2 + F_A''^2 - 2 F' F_A'' \cos \theta$$

$$F^2 = \frac{1}{2} (F^2 + \bar{F}^2) - F_A''^2$$

Thus

$$\Delta F^2 = (F^2 - \bar{F}^2) = 4 F' F_A'' \cos \theta$$

$$\text{and } \cos \theta = \Delta F^2 / 4 F' F_A'' \quad (1)$$

If  $F_A'' \ll F_A'$ , an approximate formula is

$$\cos \theta = \Delta F / 2 F_A'' \quad (2)$$

Here  $\theta$  is the angle made by the non-anomalous part of the structure factor with the anomalous part. The phase of  $F'$  is obviously  $\alpha = \pi/2 + \alpha_A - \theta$ , if all the anomalous scatterers are of the same type, e.g., all chlorines. If not, the phase angle  $\phi$  between  $F_A''$  and  $F_A'$  can be worked out from the known positions of the anomalous scatterers alone, and then

$$\alpha = \phi + \alpha_A - \theta$$

In the discussion below we shall confine ourselves to the former case when  $\phi = \pi/2$  and the extension to the more general case is obvious.

Experimentally therefore, if the difference in intensity of the reflection  $hkl$  and its inverse  $\bar{h}\bar{k}\bar{l}$  is measured accurately, then  $\Delta F^2$  can be calculated provided the scale factor is known.  $F_A''$  can be calculated from the atomic co-ordinates of the anomalous scatterers (which can be obtained in most cases from a Patterson synthesis) and the known imaginary component of their atomic scattering factors and therefore  $\theta$  can be obtained.

However, the solution for  $\theta$  from  $\cos \theta$  is ambiguous, since  $\theta$  can be either  $+\theta$  or  $-\theta$  and consequently the phase of  $F'$  determined in this way has the ambiguity given by

$$\alpha_{1,2} = \pi/2 + \alpha_A \pm \theta$$

This ambiguity is similar to the one occurring in the determination of phase by the isomorphous replacement method. In fact the scattering factor of the atoms A for the two reflections  $hkl$  and  $\bar{h}\bar{k}\bar{l}$  are effectively different and this is made use of in the determination of phase.

#### AMBIGUITY AND ITS RESOLUTION

If the group of anomalous scatterers is centrosymmetric, the phase angle  $\alpha_A$  is 0 or  $\pi$  and in this case, the two possible values of the phase of  $F'$  are  $\alpha_1 = \alpha$  and  $\alpha_2 = \pi - \alpha$ . It can be shown that if a Fourier synthesis is calculated using both the values of the phase, then the resulting

diagram would contain, in addition to the peaks of the real structure, an equal number of negative peaks, at positions related to the former by an inversion about the inversion centre of the replaceable atoms. This diagram is similar to what one obtains by performing a Patterson synthesis with  $\Delta F^2$  which has been utilised by Pepinsky and collaborators for the determination of absolute configuration.<sup>1</sup> However it is superior to the latter in that only one duplication of the structure occurs and this too in the form of negative peaks, while in the  $\Delta F^2$  Patterson, a series of images of the structure as seen from each of the atoms in the set A occurs and the whole series is duplicated in the form of negative peaks about the inversion centre.

#### EXPERIMENTAL VERIFICATION

The method has been tested in the case of ephedrine hydrochloride<sup>2</sup> in which there are two chlorine atoms per unit cell. Only  $\text{CuK}\alpha$  radiation was used and the anomalous dispersion of chlorine for this wavelength ( $\Delta f'' = 0.69$ ) was sufficient to give useful information. The difference in intensity between each pair of inverse reflections was measured accurately with a Geiger counter spectrometer for all the reflections of type  $hk0$  and the phases were calculated from expression (2). The measurements were put on an absolute scale by using the reported values of  $F_c$ . The values of  $\alpha$  as found by experiment are given in Table I together with the values of  $\alpha$  calculated from the structure determined by conventional methods. The agreement is seen to be good, the differences rarely exceeding  $20^\circ$ .

Of the two possible values, the one which is nearer to the phase of the chlorine atoms may be chosen for a preliminary synthesis and thus the ambiguity resolved. This assumption is seen to be valid in nearly 75 per cent. of reflections as may be seen from Table I. The phases of those reflections for which the contribution from the chlorine atom is zero are indeterminate and this is a defect of the method. Such reflections are small in number and this difficulty is present even in the isomorphous replacement technique.

#### COMBINATION OF THE NEW METHOD AND ISOMORPHOUS REPLACEMENT TECHNIQUE

An interesting possibility arises if a pair of isomorphous substances are available and the replaceable atoms are anomalous scatterers. This is possible for instance with hydrochlorides and hydrobromides



magnetic field, can no longer carry energy away from the plasma.

The magnetic field required for thermal insulation can be created by passing a sufficiently strong electric current—a current of some hundreds of thousands of amperes—through a rarefied gas. If an electric discharge more powerful than any lightning is created in the gas then, on the basis of theoretical considerations, it may be expected that the substance in the discharge chamber will for some millionths of a second be compressed into a thin plasmic cord severed from the walls of the chamber and heated to a very high temperature. If such a discharge takes place in deuterium, then, given a sufficiently strong current, we should observe the emission of neutrons produced as a result of the thermonuclear reaction.

On the basis of these considerations Soviet physicists organised experiments to study powerful electric discharges in gases. In these experiments they investigated phenomena arising when strong currents are passed through hydrogen, deuterium and other gases at various degrees of rarefaction. The peak current reached two million amperes, and the instantaneous energy released in such brief discharges in some of the experiments was more than ten times as great as the capacity of the Kubiyshev Hydro-Electric Station. For such experiments, however, it is not enough to have installations that make it possible to concentrate such vast energy. It is also necessary to have highly efficient apparatus of various kinds to record the development of processes in the plasma that last for some millionths of a second. High speed oscillographs, ultra-high-speed motion picture filming, cameras with electrically powered shutters, and electronic computers—all this complex arsenal of modern experimental physics was used in studying the properties of the plasma heated by an instantaneous impulse current.

Briefly, the experiments have shown that by passing a current of several hundred thousand amperes through a rarefied gas it is actually possible to heat the plasmic cord that is formed to a temperature of the order of a million

degrees centigrade. No one had succeeded in obtaining such a temperature under laboratory conditions. A higher temperature was achieved only in a hydrogen bomb. In this case, however, the investigator dare not come within less than a few kilometres of the explosion. In the experiments reported here the thin streak of the heated plasma inside the discharge chamber is not so dangerous because it consists of only a small amount of substance.

A result of these investigations that is less interesting was the discovery in 1952 of the emission of neutrons and high energy rays from the discharge. True, the emission in this case cannot be regarded as a result of thermonuclear reaction, since it is evidently conditioned in the main by processes and previously unknown processes that take place in the plasma are very much more complex than the simplified picture proposed in the initial theoretical constructions.

The facts obtained experimentally have upset many conventional conceptions about the properties of plasma, which gained their origin as a result of many years of investigation of gaseous discharges in ordinary conditions. In the plasma in the discharge chamber goes through rapid and successive compressions and expansions, during which the substance alternately converges on the centre of the discharge chamber and disperses to the walls with enormous speed reaching 100 kilometres per second. In the process, very high electric potentials—which, perhaps, are one of the basic reasons for the appearance of neutrons and penetrating X-rays—form in the plasma for a short time.

Only further investigations will be able to provide an answer to the question whether it is possible by proceeding along this path to approach the creation of a controllable thermonuclear reaction of high intensity. At the same time, it is necessary to study other methods of solving this basic problem. Of considerable interest, in particular, is the study of the possibility of obtaining a thermonuclear reaction by continuous processes of long duration.

# GLYCOLYTIC ENZYMES IN GREEN GRAM (*PHASEOLUS RADIATUS*)

K. V. GIRI AND T. RAMASARMA

Dept. of Biochemistry, Indian Institute of Science, Bangalore-3

**D**URING the past few years, considerable amount of literature has accumulated in favour of the view that the systems involved in the transformation of sugars in higher plants are strikingly similar to those found in yeast and animal tissues. The evidence for the existence of the well-known Embden-Mayerhof glycolytic pathway in plants and especially in peas has been summarised by Stumpf.<sup>1,2</sup> The importance of glycolytic cycle in the overall metabolism of plants will be appreciated only after the full documentation of the cycle in many plants. We discuss briefly the important findings made in our laboratory during the past few years on the glycolytic enzymes in green gram (*Phaseolus radiatus*) which constitutes the second important source in which all these enzymes have been identified, the first one being peas.

The two starch synthesising enzymes, phosphorylase and Q-enzyme, catalysing the following reactions have been identified in aqueous extracts of green gram seeds and their properties have been studied by Sri Ram and Giri.<sup>3</sup>

Glucose-1-phosphate  $\rightleftharpoons$  Amylose + Inorganic phosphate (Phosphorylase).

Amylose  $\rightarrow$  Amylopectin (Q-enzyme).

Phosphoglucumutase, the enzyme which brings about the equilibrium between glucose-1-phosphate and glucose-6-phosphate, has been studied in detail in green gram seed extracts by Ramasarma, Sri Ram and Giri.<sup>4</sup> Phosphoglucose isomerase which brings about equilibrium between glucose-6-phosphate and fructose-6-phosphate has been identified in green gram seeds and has been found to be distributed in every part of the plant-root, stem and leaves (Ramasarma and Giri<sup>5</sup>). The kinases which phosphorylate glucose, fructose, mannose, galactose and fructose-6-phosphate in presence of ATP have been demonstrated in green gram by Giri, Ramasarma and Nagabhushanam.<sup>6</sup> Fructose diphosphate was found to be split up into triose phosphates by aldolase of green gram and the triose phosphates were found to be oxidised in presence of diphosphopyridine nucleotide, by the combined action of triose phosphate isomerase and triose phosphate dehydrogenase present in green gram extracts. Phosphoglyceryl kinase has been identified in green gram by the Lipmann-Tuttle hydroxylamine method,

according to Axelrod and Bandurski.<sup>7</sup> Phosphoglyceromutase has been assumed to be present in peas based on the fact that 3-phosphoglyceric acid was transformed into pyruvic acid. We have been able to demonstrate this enzyme in green gram directly by the polarimetric method of Sutherland *et al.*<sup>8</sup> The reaction mixture consisted of approximately 250 micromoles of DL-2-phosphoglyceric acid (as potassium salt), 20 micromoles of sodium fluoride to inhibit the phosphatase action and 0.5 ml. of enzyme solution in a total volume of 1.5 ml. After 1 hour reaction at 37°, 0.5 ml. of 25% trichloroacetic acid was added to stop the reaction and the precipitated proteins were centrifuged and separated. The supernatant was neutralised and an appropriate aliquot was mixed with half volume of 25% ammonium molybdate and the optical rotation determined. Under the above conditions 26 micromoles of 3-phosphoglycerate was formed.

When 3- or 2-phosphoglyceric acid was incubated with green gram extract, an increase in pyruvic acid and inorganic phosphorus was observed as a result of the action of phosphatase hydrolysing phosphoenolpyruvic acid formed by enolase action. In the presence of added adenosine diphosphate, the pyruvic acid content increased indicating the presence of phosphopyruvic kinase. The reactions are presented below:

1, 3-diphosphoglyceric acid + ADP  $\rightleftharpoons$  3-phosphoglyceric acid + ATP (Phosphoglyceryl kinase).

3-phosphoglyceric acid  $\rightleftharpoons$  2-phosphoglyceric acid (Phosphoglyceromutase).

2-phosphoglyceric acid  $\rightleftharpoons$  Phosphoenolpyruvic acid + H<sub>2</sub>O (Enolase).

Phosphoenolpyruvic acid  $\rightarrow$  Pyruvic acid + Phosphate (Phosphatase).

Phosphoenolpyruvic acid + Pyruvic acid

+  $\rightleftharpoons$  +

Adenosine diphosphate + Adenosine triphosphate  
(Phosphopyruvickinase)

Carboxylase, which decarboxylates pyruvic acid and alcohol dehydrogenase which oxidises alcohol to acetaldehyde in presence of diphosphopyridine nucleotide were identified in green gram.

Despite the fact that the glycolytic cycle is functioning in green gram, the sugar transformations to pyruvic acid need not necessarily

deal *inter alia* with reactions involving the use of metal hydrides, and the author has carried out the stupendous task of a page by page examination of the leading journals and of *Chemical Abstracts*. Before proceeding to organic reductions with the hydrides the preparation and properties of complex metal hydrides are described. There are also chapters on inorganic reactions, reactions with organometallic compounds, and the use of complex metal hydrides for the determination of active hydrogen and for other analytical purposes. General considerations in the reduction of organic compounds with metal hydrides are then discussed. Ten chapters are devoted to a detailed account of the hydride reduction of organic compounds classified according to functional groups. For each group the products and yields from individual compounds are listed in tables accompanied by charts of structural formulæ. A chapter is devoted to the behaviour of LAH towards carbon-carbon multiple bonds, and the complex data are summarized very clearly. A chapter on miscellaneous reactions gives an excellent account of hydrogenolysis by LAH and of Ziegler's recent and important work on the synthesis and applications of aluminium alkyls. Two particularly useful chapters describe the experimental conditions for hydride reactions in the laboratory and on a commercial scale, drawing attention to hazards and precautions to be taken.

The book appears to be produced by litho-printing from typescript, and the printing is in very clear type. The formulæ are remarkably clear. For an American book of 1046 pages, the price is very reasonable.

This is a carefully documented, comprehensive and scholarly monograph, which will be invaluable to every organic chemist for study and reference.

K. V.

**Theoretical Principles of Organic Chemistry, Vol. I.** By W. Huckel. (Elsevier's, London and New York), 1955. Pp. xi + 904. Price 77 sh. 6d.

This truly ponderous work is a translation from the 7th edition of the original in German. It is a detailed record, in chronological order, of the important contributions that have been made towards an understanding of the theoretical principles of organic chemistry. The discussions include stereochemistry, organic molecular and complex compounds, free radicals, tautomerism, intramolecular rearrange-

ments, Walden inversion, reactions of unsaturated and aromatic compounds and course of certain chemical reactions. In most of these discussions, a good deal of space is devoted to older view-points to the exclusion at several places of more recent developments. The discussions do not necessarily suffer on this account and may serve as reminders that all fundamental theoretical advances in organic chemistry have not been made within the last few years.

A serious drawback of the book concerns the style in which it is written. The translation from the original is much too literal with the result that several passages have to be read over and over again before the meaning becomes clear. Lengthy and complicated sentences occur a little too frequently and retard easy reading.

In spite of this handicap, the book is still stimulating and worth careful study. There is no doubt that one can profit from its wide and critical survey of theoretical organic chemistry.

S. SWAMINATHAN.

**Polymyxin, Neomycin, Bacitracin.** (Antibiotic Monographs No. 5). By Ernest Jawetz. Foreword by H. Welch and Felix Marti-Ibanez. (Medical Encyclopædia, Inc., New York.) Pp. 96. Price \$4.00.

This monograph presents material of value to the pathologist and the clinician about the three antibiotics, which though not as widely used as penicillin, streptomycin or the tetracyclines, are nevertheless of value in special cases. Under each antibiotic, an informative account is given of what needs to be known regarding the history, chemistry, antimicrobial activity, absorption and excretion, toxicity, clinical use, etc. The indications and contraindications have been particularly stressed and the coverage of matter is thorough. There is a useful bibliography listing 205 publications; of these, only 17 on polymyxin originates from Britain, the rest are from America.

The get-up of the monograph and the printing are undoubtedly attractive and the reviewer agrees fully with the editors that "this clear concise monograph thoroughly covers the subject-matter". He also recommends it to those who wish to know about the clinical usefulness of polymyxin, neomycin and bacitracin, but the price is clearly a little too high.

K. GANAPATHI.

**Silver Jubilee Souvenir, 1955.** (Society of Biological Chemists, India), 1955. Pp. xvi + 262.

The *Silver Jubilee Souvenir* of the Society of Biological Chemists, India, is an interesting volume containing contributions from eminent biochemists both in India and abroad. The subjects dealt with are varied and include: A Colorimetric Method of Assay and the Partial Purification of Beef Liver Esterase, The Biochemistry of Human Genetics, Visual Pigments, Ascorbic Acid and Hydrogen Peroxide in Metabolism, Biochemistry of the Labile Methyl Group, Hypothermia and Its Induction by Drugs, Diabetes as a Disturbance of Carbohydrate Metabolism, The Role of Nucleotides in the Biosynthesis of the Nucleic Acids, Biochemical Engineering, Deuterium Exchange between  $\beta$ -Lactoglobulin and Water, Alkaloids from the Leaves and Roots of *Rauwolfia canescens* L., etc. This makes the volume a brilliant record of some of the achievements in the field of biochemistry during recent years.

The fact that several biochemists from other countries have contributed to this volume, shows the goodwill which the Society of Biological Chemists enjoys in the international field. The *Souvenir* is a fitting memorial to the Silver Jubilee of the Society.

M. V. R.  
S. M. P.

**Annual Report for 1954-55—Nutrition Research Laboratories.** (Indian Council of Medical Research, Coonoor, S. India), 1955. Pp. 36.

The booklet under review gives in detail the work carried out by the Nutrition Research Laboratories, Coonoor, during the year 1954-55. The research work relates to studies on vitamins, proteins, fats and investigations carried out in the nutrition clinic and in the field as also on a research project connected with protein malnutrition. Further, the interrelationship between rice diet and fertility has also been studied. Among the important findings, special mention may perhaps be made of the development of a fluorimetric method for vitamin A determination, the unusual observation that a certain species of amaranthus known as "Raj-keera" has a high content of lysine, the effective treatment of a number of cases of 'Kwashiorkar' with Bengalgram and Bengalgram-rice-calcium lactate diets and a study of the role of material malnutrition in 'Kwashiorkar' by clinical and biochemical findings in two hundred antenatal cases. Further, animal experiments with albino rats carried out under rigidly

controlled conditions have shown no difference in the fertility rate of animals maintained on 'rice diets' and 'wheat diets'. In regard to maintenance requirements of proteins in young adults, the report could have been more explicit, particularly in regard to the definition and calculation of biological value (B.V.), egg replacement value (E.R.V.) and negative nitrogen balance. However, the results obtained with five healthy young adults appear very interesting and should be confirmed by carrying out similar experiments on a larger number of persons. The report gives in the end a list of scientific meetings held, education and advisory work carried out and the titles of eighteen publications in *Indian Journal of Medical Research* and other scientific journals. One is indeed struck by the remarkable progress made in different fields of nutrition research during the period under review. It is to be hoped, that in the years to come, much more impressive and useful work will be carried out by this premier research institution devoted to a study of all aspects of nutrition research in this country.

P. S. SARMA.

**Recent Research on Vitamins.** (*British Medical Bulletin*, Vol. 12, No. 1.) (The Medical Department, The British Council, 65, Davies Street, London, W. 1), 1956. Pp. 90. Price 15 sh.

This brochure published as a memorial to the late Sir Edward Mellanby, will be welcomed by many scientists in India, particularly because they had the opportunity of meeting him and knowing him during the period he was in this country as the first Director of the Central Drug Research Institute at Lucknow. The introduction written by Sir Rodolph Peters and an appreciation of Mellanby by Sir Charles Harington precede the seventeen articles written on different vitamins by several English authors. The articles are more in the nature of reviews, giving the latest position of that subject and the possible future lines of development in that particular field.

Special mention may perhaps be made of the article on 'Vitamins and the Protection of the Liver' in which C. H. Best, C. C. Lucas and J. H. Ridoubt discuss in detail the role of active methionine and other lipotropic factors. L. J. Witts has reported in another article the recent work on B vitamins in the blood and gastro-intestinal tract, especially in relation to human diseases. There are two articles by H. M. Sinclair in regard to the relationship

an interval of four, eight, thirteen and seventeen months. The animals remained solidly immune up to 13 months while two animals out of the last batch tested 17 months after vaccination reacted mildly on challenging them with Foot and Mouth Disease Virus type 'O'. The control animals showed quite a severe reaction in all the tests. From the observations there is evidence of adequate immunity for about 17 months.

With a view to ascertain the comparative value of crystal violet vaccine (Mukteswar) and the 'gel' vaccine bivalent types O and A (Copenhagen) a consignment of the latter was obtained from State Serum Institute, Copenhagen. Four hill-bulls, four sheep and four goats were inoculated with 32 c.c. and 15 c.c. each respectively and were tested for immunity 36 days after they were vaccinated. One of the hill-bulls, two goats and one sheep reacted severely. It is quite evident from the above observations that the immunity conferred by this vaccine was of shorter duration than that of crystal violet vaccine.

It has been found that crystal violet vaccine is simpler to prepare and is as efficacious as the "adsorbed" vaccine. There is experimental evidence indicating that the duration of immunity also is longer. Further work is in progress and efforts are being made for wider application of the vaccine in the field.

Div. of Pathology and V. R. GOPALAKRISHNAN.  
Bacteriology, C. SEETHARAMAN.  
Indian Vet. Res. Inst., H. S. DHILLON.  
Mukteswar, Kumaun, U.P.,  
April 20, 1956.

1. Waldmann, O., *Nature*, 1938, **142**, 58.
2. Schmidt, S., *C. R. Soc. Biol.*, 1936, **123**, 193.
3. Graub, *Schivies. Arch. Tierheilk.*, 1939, 81.

### THE INTENSITY OF RAMAN LINES IN SPECTRA OF SOLUTIONS OF PYRIDINE IN ACETIC ACID

IN his recent papers Lakshmanan<sup>1</sup> published the results of his study on the Raman spectra of pyridine solutions in fatty acids. He notices some displacements of the Raman lines of pyridine and also the appearance of a new line 1006  $\text{cm}^{-1}$ . According to Lakshmanan, the intensity of the new line reaches a maximum for a solution containing 20 mol. % of pyridine and 80 mol. % of acid.

Similar studies have been made in our laboratory. We have observed similar changes in the spectrum of pyridine, and particularly, the

appearance of a new line of 1007  $\text{cm}^{-1}$ , the exact frequency the concentration of the solution was considered to be due to symmetric oscillations of a  $\text{C}_6\text{H}_5\text{N}$  molecules which form complex molecules of acetic acid. Attention directed to the pyridine solution. We have examined the solutions of different concentrations measured the frequency of well as the intensity of the new line.

For this purpose the spectra were photographed on the same conditions. Photometry then taken by means of a microphotometer. To measure the 1003  $\text{cm}^{-1}$  line for that purpose a spectrum between about 985 and 1029  $\text{cm}^{-1}$  was transformed into a density contour by means of a microphotometer. Some of the results are shown in Fig. 1.

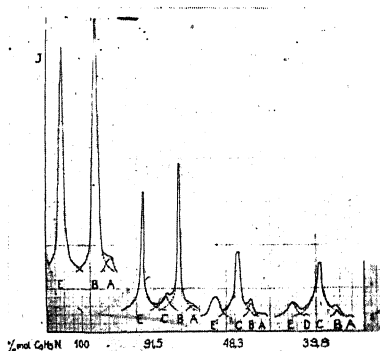


FIG. 1

are shown in Fig. 1. The lines were carefully analysed and separated. The latter are marked with dashed lines. The lines of pyridine at 1029  $\text{cm}^{-1}$  are indicated by dashed lines. The lines of pyridine at 1029  $\text{cm}^{-1}$  are indicated by dashed lines. The new line of 1007  $\text{cm}^{-1}$  is marked every week.

The intensity of this line was measured by integrating the area of this line. The results of the measurements made on three different solutions are represented by points on the graph. The intensity of this line was measured as a function of the concentration of pyridine. In spite of the fact that the experimental errors are as high as 10%, it is easily seen that the intensity of this line increases with the concentration of pyridine in the solution and takes on its maximum

During analysis of the spectrum of this solution, the  $989\text{ cm}^{-1}$  line was also discovered. From this it may be concluded that in such a solution, in addition to the pyridine molecules which form complexes, there are a number of free pyridine molecules.

The rough assumption is made that the scattering cross-sections of all the pyridine molecules forming complexes do not depend on the solution concentration. Considering that according to the law of mass action, the largest number of such pyridine molecules occurs for a solution in which the ratio of the number of pyridine molecules to the number of acetic acid molecules is the same as in the complex, it is concluded that the complex formed in the solutions investigated contains one molecule of pyridine and one of acetic acid.

The value of the ratio of intensity of the new line to the molar concentration of pyridine has no physical sense for the solutions containing more than 40 mol. % of pyridine, for, as we have seen, in such solutions complexes are not formed by all pyridine molecules present. In more dilute solutions, the value of this ratio decreases somewhat, but this decrease lies within the experimental error. Thus the assumption that the scattering cross-section remains constant for pyridine molecules forming complexes seems to be justified.

tions of pyridine in formic acid containing 10 and 5 mol. % of pyridine, we have found lines of frequencies  $1022$  and  $1025\text{ cm}^{-1}$  respectively, in agreement with Lakshmanan's results. It is still an open question whether these lines have an analogue in the line  $1020\text{ cm}^{-1}$  observed in spectra of acetic acid solutions of pyridine, or whether they have to be identified as a displaced line of pure pyridine  $1029\text{ cm}^{-1}$ .

On the basis of the dependency of several physico-chemical constants on the concentration, Lakshmanan assumes that there are complexes built of one molecule of pyridine and four molecules of acid in solutions of pyridine and fatty acids. Lakshmanan's experimental results that the line  $1006\text{ cm}^{-1}$  has a maximum intensity in solutions containing 20 mol. % of pyridine seems to confirm his conclusions. These conclusions do not agree with those arrived at on the basis of the measurements presented in this paper.

Had there been a complex of the kind assumed by Lakshmanan and had it been manifested by a new line in the spectrum, it should have been the D line in Fig. 1, rather than that of  $1006\text{ cm}^{-1}$  frequency.

The author would like to thank Professor J. Pniewski for his interest in this work and his many valuable suggestions.

Institute of Physics, ROMAN MIERZECKI,  
Polish Academy of Science,  
Warsaw, Poland,  
April 26, 1956.

1. Lakshmanan, B. R., *J. Indian Inst. Sci.*, 1954, **36**, 97, 214.
2. Mierzecki, R., *Acta Phys. Polon.*, 1953, **12**, 26.
3. —, *Bull. Acad. Polon. d. Sciences Cl. III*, 1955, 258, 262.
4. Kohlrausch, K. W. F., *Ramanspektren*, Leipzig, 1943, 5.

#### A CASE OF PLEIOTROPY IN PIGEON PEA

SINGH, BANSAL AND MITAL<sup>1</sup> recorded in pigeon pea [*Cajanus cajan* (L.) Millsp.] a new variant to which they gave a specific rank and designated it as *Cajanus obcordifolia* Singh. The variant possessed obcordate leaflets with mucronate apex and the petals constituting the keel of the flower were free and filiform. Normally the leaflets in pigeon pea are lanceolate, with acuminate apex and the petals forming the keel are joined together and are not filiform.

Inheritance studies, since conducted by the present authors, have shown that the variant described by Singh *et al.* yields fully fertile

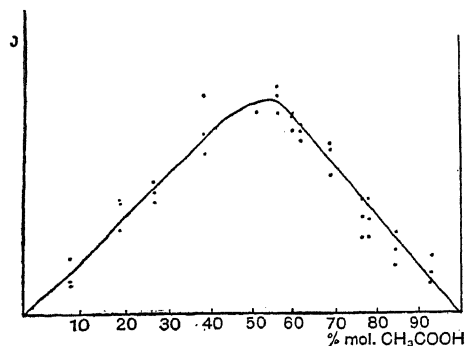


FIG. 2

In Fig. 1 for more dilute solutions, a line D of frequency near  $1020\text{ cm}^{-1}$  is also seen. So far, the existence of this line has not been explained. Kohlrausch<sup>4</sup> reported the existence of a very weak line of acetic acid of frequency  $1020\text{ cm}^{-1}$ . Under our working conditions this line has not been observed in spectra of pure acetic acid. It does not seem probable however that the line observed is a reinforced line of acetic acid. On the other hand, this line may constitute another modification of the  $989\text{ cm}^{-1}$  pyridine line. Formic acid has no line in this region, but in the spectra of solu-

# THE DEVELOPMENT OF ENDOSPERM IN *SCILLA INDICA* BAKER

THE development of endosperm in the so far investigated species of *Scilla*, one of the extremely interesting genera of Liliaceae, is recorded to be of the nuclear type.

After fertilization the embryo sac with the broad basal part is enclosed by the nucellar remains, the inner and outer integuments. The strong vascular supply of the ovule extends to the densely

nucleate chambers soon become binucleate after a nuclear division (Fig. 4). The nuclei of the chalazal chamber do not go further divisions but become highly enlarged (Figs. 5-6) and often acquire an aril-like shape (Fig. 7). This chamber with dense vacuolate cytoplasm gradually extends towards the chalaza by crushing most cells (Figs. 5-6). Meanwhile the two nuclei of the micropylar chamber undergo repeated nuclear divisions giving rise to a large

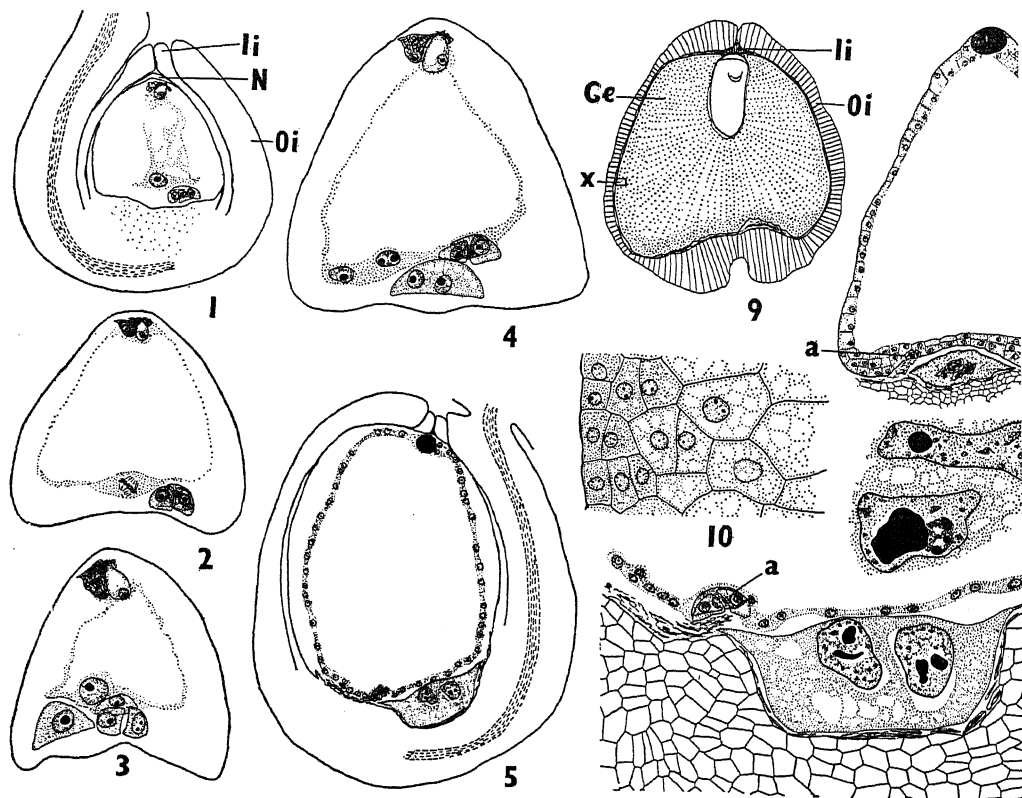


FIG. 1. L.s. ovule with embryo sac after fertilization,  $\times 49$ . FIGS. 2-3. First division of primary endosperm nucleus,  $\times 157$ . FIG. 4. Binucleate chalazal and micropylar chambers of the embryo sac,  $\times 157$ . FIG. 5. L.s.  $\times 47$ . Note the binucleate chalazal and multinucleate micropylar chambers of the embryo sac. FIG. 6. Chalazal chamber with surrounding parts of Fig. 5 enlarged,  $\times 151$ . Note the persisting antipodal cells. Two nuclei of the chalazal chamber showing irregular shape,  $\times 483$ . FIG. 8. Cell wall formation in micropylar chamber,  $\times 34$ . Note the degenerating chalazal chamber. FIG. 9. L.s. fairly old seed,  $\times 47$ . FIG. 10. A portion of endosperm at the mark  $\times$  in Fig. 9 enlarged,  $\times 209$ . (a, antipodal cells; Ce, cellular sperm; li, inner integument; N, nucellar remains; Oi, outer integument.)

cytoplasmic chalazal part. The primary endosperm nucleus is situated near the antipodal cells in the basal region (Fig. 1). Its first division is followed by a cell wall and the embryo sac, consequently, becomes divided into a small chalazal chamber and a very large micropylar chamber (Figs. 2-3). Both the uni-

cellular nuclei which remain embedded in a layer of cytoplasm at the periphery of the embryo sac (Fig. 5). Soon this is followed by a simultaneous cell wall formation (Fig. 6). The subsequent growth of endosperm is towards the petal and the large central cavity of the embryo sac gradually becomes filled with

endosperm tissue (Fig. 9). The peripheral cells of the endosperm are small with dense cytoplasm compared with the cells of the central region (Fig. 10).

As cell walls are laid down in the micropylar chamber, the activity of the chalazal chamber gradually declines and finally the chamber degenerates. During the development of endosperm, the embryo sac enlarges enormously, crushing the entire nucellus and the inner integument except an insignificant portion at the micropylar region (Fig. 9). The antipodal cells take deep stain and are persistent (Figs. 6 and 8).

The mode of endosperm development in *Scilla indica* is, therefore, not nuclear as in the other investigated species but Helobial. A careful investigation of the development of endosperm of the uninvestigated species of *Scilla* coupled with other embryological data may throw further light on the grouping of genera in the subfamily Scilloideæ.

It gives me great pleasure to record my gratitude to Professors K. N. Narayan and S. B. Kausik for their encouragement and guidance during the course of this investigation. I am highly thankful to Dr. M. S. Chennaveeriah for having collected the material for me near Bombay.

Dept. of Botany, D. A. GOVINDAPPA.  
Central College, Bangalore-1,  
May 26, 1956.

1. Buchner, Leopoldine, *Österr. Bot. Zeitschr.*, 1948, 95, 428.
2. Cave, Marion, *Plant Genera, Chronica Botanica*, 1953, 14, 140.
3. Schnarf, K., *Vergleichende Embryologie der Angiospermen*, 1931, Berlin.
4. Stenar, H., *Acta Horti Bergiani*, 1950, 15, 169.
5. Wunderlich, Rosalie, *Flora*, 1937, 32, 48.

#### IMMUNISATION OF CATTLE AGAINST FOOT AND MOUTH DISEASE WITH CRYSTAL VIOLET VACCINE

As early as 1938 Waldmann's method<sup>1</sup> of vaccination against Foot and Mouth Disease—a modification of Schmidt's original method<sup>2</sup> was extensively used in Germany. It consisted in treating the Foot and Mouth Disease virus and epithelium recovered from the tongue of cattle with aluminium hydroxide and formalin, thereby rendering the virus innocuous. This aluminium hydroxide "adsorbed" vaccine is also being used in other countries of Europe. The duration of immunity is reported to be for 6-8 months. Besides, other modifications have been

tried using crystal violet, chloroform, etc. Graub<sup>3</sup> made the first experiment using crystal violet dye in the preparation of the vaccine.

Under the auspices of the Indian Council of Agricultural Research, a research scheme is working at the Indian Veterinary Research Institute, Mukteswar, with the object of devising a suitable method of vaccination for the control of Foot and Mouth Disease among cattle in India. This is a disease of much economic importance as the losses due to reduced working capacity, diminished milk yield, deaths of affected animals, etc., amount to about 4 crores of rupees annually. A complicating and rather difficult factor to be reckoned with in the control of the disease is that there are three different types of virus, O, A and C, which are immunologically distinct and so a vaccine should be a polyvalent one containing the three types for general prophylactic measure. However, a mono- or a bivalent vaccine can with advantage be used in conducting preventive vaccination against any, one or two types respectively. This note gives a preliminary account of the preparation of and the successful immunisation of animals with crystal violet vaccine evolved at this Institute.

The polyvalent vaccine is prepared by reinforcing the blood, drawn at the height of thermal reaction from the reacting hill-bulls with 7.5% suspension of tongue epithelium, 2.5% suspension of each type of virus. The epithelium along with the lymph of vesicles on the tongue is collected aseptically from the bulls inoculated with a bovine strain of the virus. The material is weighed and then cut into very small pieces and triturated in a mortar. Sufficient quantity of buffer phosphate, pH 7.6, is added so as to enable centrifuging it for the removal of tissue particles. The blood collected from the hill-bull is incorporated. Finally crystal violet solution, sterilized at 60° C. for half-an-hour, is added in the concentration of 0.03%. The vaccine is now incubated at 37° C. for 10 days. Later, it is tested for purity, safety and potency. The dose for adult cattle is 30-40 c.c. given subcutaneously.

Experimental vaccination of animals both in the laboratory as well as in the field was carried out to assess the value of the vaccine. 24 Buffalo-calves were vaccinated with the crystal violet vaccine monovalent type 'O' at Military Farm, Bareilly. They were tested for immunity in batches of six animals each after



## REVIEWS

### Scattering and Diffraction of Radio Waves.

By J. R. Mentzer. (Pergamon Press), 1955. Pp. viii + 134. Price 30 sh.

This is a book in the series of monographs on *Electronics and Waves*, edited by Mr. D. W. Fry of Harwell.

The book deals with the mathematical methods of treating the problem of scattering of electromagnetic waves by bodies of different shapes with a view to their application to the calculation of echo cross-sections of radar targets. Rigorous calculations are possible only in a few simple cases such as a conducting or dielectric sphere, a long cylinder, an infinite conducting cone, a thin conducting plate, etc., the essential condition being that the wave equation can be "separated" in a co-ordinate system which is suited to the shape of the scattering object. In addition to the classical method, an alternative vector variational method due to Schwinger which can be used to obtain approximate solutions of practical diffraction problems is explained and applied to the important case of scattering by thin wires.

The last chapter deals with the techniques in use for the measurement of radar cross-sections of complicated scatterers like aircraft, using scale models on a convenient smaller scale and corresponding shorter wavelengths.

The book has many neat diagrams and is well printed. The exposition is clear and the book will prove very useful to advanced students and instructors in radio and radar physics. The price (30 sh.) is rather high for a book of 134 pages.

K. R. RAMANATHAN.

**High Vacuum Technique.** 3rd Edition. By J. Yarwood. (Chapman & Hall), 1955. Pp. viii + 208. Price 25 sh.

Modern high vacuum technique started with the pioneering work of Gaede in 1910 and since then, it has made several rapid strides, in answer to the need for very high order of vacua to be maintained in large vacuum systems, both in the laboratory and industry. The appearance of a third edition of the book under review, within the last twelve years, indicates both the popularity of this book and the growing trends in the subject.

Compared to the previous editions, substantial additions have been made. Diffusion pump theory is analysed in greater detail and a number of recent innovations in vacuum gauges like valves and other control devices are discussed. An important feature is the comparative data on the availability and performance of various types of rotary and diffusion pumps, oils and measuring devices of different manufactures. This information, together with the last chapter on the properties of some of the important materials used in vacuum technique, will be very useful for constructing a vacuum system.

The subject-matter is practically up-to-date except for some of the attempts, since 1945, at producing high vacua, without any working fluid like oil or mercury. But this is indicated in principle, in the discussion of the pumping action of the ionisation gauge.

This, however, is a very minor criticism of an excellent book which will be instructive and informative for physicists and engineers.

K. S. CHANDRASEKARAN

**Antimetabolites and Cancer.** Edited by C. P. Rhoads. (American Association for the Advancement of Science Publication), 1955. Pp. 312. Price \$5.75.

"Once cancer, always cancer" seemed to be the dictum, as voiced by C. P. Rhoads, of a school of cancerologists who believe in the somatic mutation as the origin of cancer. Since this hypothesis implies that mutations cannot be reversed or prevented by environmental or directive manner, this view-point is tinged with fatalistic implications. The field, however, is not so gloomy as it appears. For example, there is another school of workers who would like to consider cancer "as resulting from aberrations in morphogenesis" (Davis). "Since the morphogenetic changes do involve directive environmental influence, the morphogenetic aberration hypothesis has a much more cheerful implication, in that, if only we learn to modify the environment of a cell appropriately, we may be able to prevent or even reverse the neoplastic developments."

Whatever be the theories of the origin of cancer, the job of a person seeking to cure it becomes one of devising means for the selective restraint of growth or the destruction of

neoplastic cell, no matter where in the body it may be. Till recently, the only hope lay either in radical surgery or in radiation therapy, both of which have cured many early cancers. Recently a new and a promising tool, namely, antimetabolites, has been added in the armoury against cancer.

Interference with normal growth-pattern by inducing a chemical competition between a synthetic compound and an essential metabolite has been known for quite some time; but its potential implications were recognised only after its applications in bacteriostasis have been amply rewarded. The antimetabolite principle was first tried in chemotherapy of cancer as late as 1948. During the last six to seven years the field has grown so enormously that it is difficult to keep track of all the developments even for those who are actively on the lookout for information. The volume under review which records the proceedings of a symposium on Antimetabolites and Cancer, held under the auspices of the American Association for the Advancement of Science in 1953, is therefore a welcome one, even though its scope is limited to contributions from American workers only.

As the title of the book would suggest, the major portion deals with chemotherapy of cancer. There are, however, sections dealing with the applications of the antimetabolite principles in the studies of plant material, and of the protozoon *tetrahymena* as also in the normal mammalian fetal development.

Among the antimetabolites extensively investigated, aminopterin and A-methopterin feature prominently as the folic acid antagonists, and 2:6 diaminopurine, 6-mercaptapurine, 8-azaguanine and other analogues of purines and pyrimidines as the antinucleic acid metabolites. One of the necessary evils of antimetabolite therapy is the acquired drug resistance. This has partially been discussed although the reviewer would have liked to see this extensively discussed, since this forms the basis of the usefulness or otherwise of the antimetabolite principle. On the whole, the book is a very thought-provoking one and will be useful for all biological workers and particularly for those interested in the problem of cancer.

M. B. SAHASRABUDHE.

**Rain-Making; Its Present Position and Future Possibilities.** By A. K. Roy. (Published by CSIR, New Delhi), 1955. Pp. iii + 28.

Much has been written on this subject in the last few years in the scientific and the lay press, and the informative article by A. K.

Roy who is in charge of the Experimental Rain Cloud Physics Research Unit of the Council of Scientific and Industrial Research is very welcome. The article starts with the mode of rain formation in clouds, and discusses the possibilities of rain-making in supercooled and 'warm' clouds. This is followed by a critical assessment of the results of rain-making experiments conducted so far, and the article concludes by indicating the limitations of known techniques of rain-making. The monograph is well illustrated and includes a few photographs of successful rain-making, and contains also a select bibliography.

**Methods in Enzymology, Vol. I.** Edited by S. P. Colowick and N. O. Kaplan. (Academic Press), 1955. Pp. 835. Price \$ 18.00.

The present volume is the first of a series of four which the publishers propose to bring forth. The objective, as stated in the preface, is to present "for the first time in the English language, a comprehensive compilation of the methods used in the study of enzymes. In certain respects, this work should serve as a companion piece for Sumner and Myerback's "The Enzymes", in which methodology has been emphasised".

The book consists of four sections: general preparative procedures, enzymes of carbohydrate metabolism, enzymes of lipid metabolism and enzymes of citric acid cycle. As the name of the book indicates, much stress is laid on the methodology of enzymes, each enzyme being dealt with under the heads—assay methods, purification and properties. Section I is devoted to the general preparative procedures comprising tissue slice technique, tissue homogenates, fractionation of cellular components, methods of extraction and fractionation, and preparation of buffers. Section II deals with the enzymes of carbohydrate metabolism, preparation, purification, assay methods and properties of enzymes relating to the hydrolysis and synthesis of polysaccharides, metabolism of hexoses, pentoses, three-carbon compounds, two-carbon compounds and formate reactions. Section III relates to the enzymes of fatty acid oxidation and acyl transfer and activation; lipases and esterases and phospholipid and steroid enzymes. The enzymes of citric acid cycle have been dealt with in Section IV.

Leading scientists all over the world who are specialists in the particular field have contributed various articles in this book. Although it is not an exhaustive account of all aspects

designation is according to their density or  $\sigma_t$ . For example, the high-temperature low-salinity water having a  $\sigma_t < 19.00$  is called Northern Dilute Water;  $\sigma_t = 19.00-21.00$  Transition Water;  $\sigma_t = 21.00-22.00$  Southern Bay of Bengal Water;  $\sigma_t = 22.00-23.00$  Upwell Water; and  $\sigma_t = 23.00-24.00$  Subsurface Shelf Water.

The Northern Dilute Water is formed in the northern part of the Bay of Bengal and is comprised of a large quantity of fresh-water discharged by the great rivers in that region. The heavier Southern Bay of Bengal Water is characteristic of the water at the surface at the south end of the Bay. Mixtures of the two are usually found somewhere in the Bay. The Upwell Water is found in spring adjacent to the coast, having upwelled from subsurface layers. The other still heavier water-masses never reach the surface.

The temperature and salinity limits vary widely in the surface layers, but must fall within the assigned  $\sigma_t$  limits. However, the

conventional deeper water-masses in the Indian Ocean<sup>2</sup> are more uniform having more restricted ranges of temperature and salinity. They are called Indian Equatorial Water, Indian Central Water, Red Sea Water, Antarctic Intermediate Water, Subantarctic Water, Circumpolar Water, and Antarctic Bottom Water.

On examination of the T-S diagrams (Fig. 1), constructed from the data collected in March 1953, the water-masses present can be identified. In this month the current off the east coast is flowing to the north-east. The Northern Dilute and Transition Water are not present now, having been dissipated by mixing with heavier water. The top stratum which extends down to 90 meters is composed of Southern Bay of Bengal and Upwell Water. Between 90 and about 160 meters is found the Subsurface Shelf Water and the Upper Limit of Indian Equatorial Water. The depths of the water-mass layers depend upon distance from shore and season.

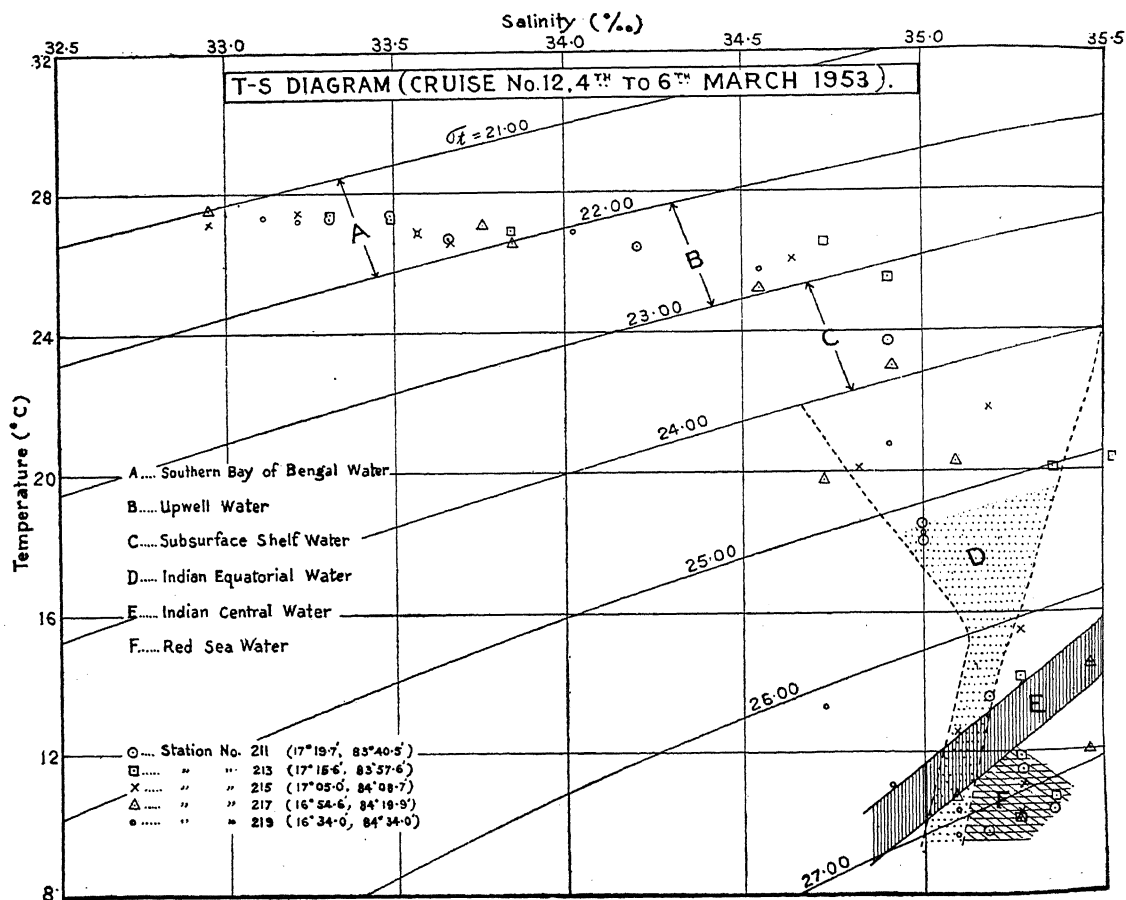


FIG. 1

No. 2  
Feb. 1956]

The deep water-masses present, in addition Indian Equatorial Water, appear to be Indian Central Water and Red Sea Water as shown in the figure by shaded bands.

The results arrived at are to be treated as tentative and more data are required to state precisely the nature of water-masses present and their characteristics. Study of the deeper waters is also called for, to understand more about the structure and circulation of the waters in the deeper layers.

The author is thankful to Prof. E. C. La Fond for guidance in the work.

Andhra University, C. POORNACHANDRA RAO.\*  
Maitair, October 3, 1955.

1. Sewell, R. B. Seymour. *Memoirs of the Royal Asiatic Society of Bengal*, 1938, 9, 357.
2. Sverdrup, H. U., *Oceanography for Meteorologists*, 1942, 159.
3. La Fond, E. C., *Andhra University Memoirs*, 2 (in press).

\* Now with India Meteorological Department, Poona 5.

## NUCLEAR SCATTERING OF HIGH ENERGY ELECTRONS BY LIGHT ELEMENTS

The nuclear elastic scattering of 125 Mev. electrons by beryllium has been observed by Hofstadter, Fechter and McIntyre,<sup>1</sup> while that of 190 Mev. electrons by beryllium has been observed by McIntyre, Hahn and Hofstadter.<sup>2</sup> Gautha, Shah and Gatha<sup>3</sup> have correlated these experimental relative differential scattering cross-sections on the basis of a characteristic clear form factor given by

$$g(\vec{s}) = a_1 \exp(-\beta_1 \vec{s}^2) + a_2 \exp(-\beta_2 \vec{s}^2) / \{1 - \beta_3 \vec{s}^2 + \beta_4 \vec{s}^4\} \quad (1)$$

where

$$a_1 = 0.0022 \text{ mb.}, \quad a_2 = 0.0078 \text{ mb.}$$

$$\beta_1 = 0.29 \times 10^{-26} \text{ cm.}^2, \quad \beta_2 = 0.23 \times 10^{-26} \text{ cm.}^2$$

$$\beta_3 = 0.04 \times 10^{-26} \text{ cm.}^2; \quad \beta_4 = 0.0075 \times 10^{-52} \text{ cm.}^4$$

The above theoretical characteristic form factors have been obtained from the characteristic clear density distribution determined by Gautha and Shah,<sup>4</sup> on the basis of the nuclear scattering of 340 Mev. protons. Recently Fregeau and Hofstadter<sup>5</sup> have observed the nuclear elastic scattering of 187 Mev. electrons by carbon. The theoretical consequences of these observations have been considered in the present investigation.

It may be noted that the experimental observations on beryllium provide only the rela-

tive values of the differential cross-sections, while the experimental observations on carbon provide the absolute values for the same. Therefore, while the experimental values of  $g(\vec{s})$  for beryllium are relative, those for carbon are absolute. It has been shown by Advani, Shah and Gatha<sup>3</sup> that the experimental relative  $g(\vec{s})$  for beryllium can be made to agree with the theoretical  $g(\vec{s})$  after suitable normalization. The experimental absolute  $g(\vec{s})$  for carbon can also be made to agree with the theoretical  $g(\vec{s})$  by an appropriate renormalization. The theoretical  $g(\vec{s})$  and such normalized experimental  $g(\vec{s})$  are shown in Fig. 1 as represented by Curve A and the corresponding experimental points. It is clear that a satisfactory agreement, between the theoretical and normalized experimental  $g(\vec{s})$ , has been obtained. However, such a renormalization of the experimental absolute  $g(\vec{s})$  for carbon presupposes that the original normalization is incorrect. In view of the original normalization process, used by Fregeau and Hofstadter,<sup>5</sup> such an assumption appears untenable.

Assuming that the original normalization of experimental  $g(\vec{s})$  for carbon is correct, the experimental relative  $g(\vec{s})$  for beryllium have been normalized again so as to make all the experimental values of  $g(\vec{s})$  to lie on a smooth curve. Such a curve, together with these values of experimental  $g(\vec{s})$ , are also shown in Fig. 1 by the curve B and the corresponding experimental points. It may be noted that the theoretical value of  $g(0)$  is determined, irrespective of the nature of the charge density distribution, on the basis of its normalization only.

It is clear that  $g(\vec{s})$ , represented by curve A, is due to a characteristic nuclear proton density distribution which has been assumed to have the same form as the characteristic nuclear density distribution for nucleons. On the other hand, the  $g(\vec{s})$  represented by curve B, must be regarded as due to a characteristic nuclear proton density distribution which may not have the same form as the characteristic nuclear density distribution for nucleons. It is considered unlikely at this stage, that the difference between  $g(\vec{s})$  of curve A and  $g(\vec{s})$  of curve B can be ascribed to any error in the determination of the characteristic nuclear density distribution for nucleons by Gautha and Shah.<sup>4</sup> Thus, one has to ascribe this difference to an inherent difference in the characteristic nuclear proton density distribution and the characteristic nuclear density distribution for nucleons. This would mean that the characteristic nuclear

This question has also been discussed at length by Abraham<sup>4</sup> more recently. He observes that the essential requirements for the fundamental unit of time are that it must be the same whenever and wherever it is needed and that it must be susceptible of exact measurement. (The actually observed quantity need not be constant provided its relationship to the fundamental unit is known.) There can, moreover, be only one fundamental standard, and this should be the standard of Ephemeris Time. This standard should be retained be-

cause its stability and permanence are independent of its users, and also because it can be measured with sufficient accuracy for the purpose. In his opinion atomic clocks are to be recommended only as the precise and accessible sub-standards.

1. Essen and Parry, J. V. L., *Nature*, 1955, **176**, 280.
2. Bullard, E. C., *Ibid.*, 1955, **176**, 282.
3. Clemence, G. M., *Ibid.*, 1955, **176**, 1230.
4. Abraham, H. J. M., *Austr. J. Sci.*, 1956, **18**, 103.

### THE INTERNATIONAL ATOMIC ENERGY AGENCY

**A**N international agency for the development of the peaceful uses of atomic energy is to be established early in 1957, subject to the ratification of the statute by a special assembly of the UN to be held in September.

The agency will encourage and assist research, development and the practical application of atomic energy for peaceful uses throughout the world and will foster the exchange of scientific and technical information as well as the exchange of scientists and of experts among nations. Its chief purpose would be to act as a "bank" to receive, store and issue uranium fuels and other atomic materials and thus to make them available to the industries of the world beyond the borders of the few countries that can produce these materials.

Under the present draft of the statute, the agency could accept the 440 lb. of uranium-235 which the United States proposed in 1954 to contribute for international purposes, the 44 lb. allocated by the United Kingdom, and the unspecified amount that the Soviet Union has offered. None of these offers have, of course, been made to the agency as such, since it is not yet in existence. But the total would represent a large capital endowment. The U.S. Atomic Energy Commission has set a price of \$ 25 a gram on uranium-235, so that the amount proffered, 200,000 grams, would be worth five million dollars.

Even broader is another function of the agency. It will make provision for materials, services, equipment and facilities to meet the needs of research and the practical application of atomic energy for peaceful uses, including

the production of electric power, with due consideration for the needs of the underdeveloped areas of the world. This seems to envisage a large function of leadership in atomic development. The agency is also authorized to acquire or establish any facilities, plant and equipment useful in carrying out its authorized functions, whenever the available facilities in the area concerned are inadequate or unavailable on satisfactory terms.

Since the fissionable materials could be diverted to military purposes and since their use in atomic reactors involves the production of materials that emit radiations, the Agency will also establish and operate a complete system of safeguards, both to prevent misuse of materials, equipment or information and to assure the protection of health, life and property from possible hazards. This includes the establishment of a staff of inspectors who will be responsible for the maintenance of safeguards and protective measures, not only by the Agency itself but by member States engaged on projects under agreement with the Agency.

There is no specific provision in the draft of the statute for any study or action by the Agency with regard to the training of atomic specialists or the introduction of educational improvements that the atomic age will demand in many countries. Neither is there any consideration of the vast economic and social consequences in industry, agriculture, medicine and society. Many of these fall within the scope of present organs of the United Nations and may therefore be left to the latter or undertaken co-operatively.—UNESCO.

## WATER REQUIREMENT OF IRRIGATED WHEAT—VARIETY KENPHAD

S. VENKATARAMAN

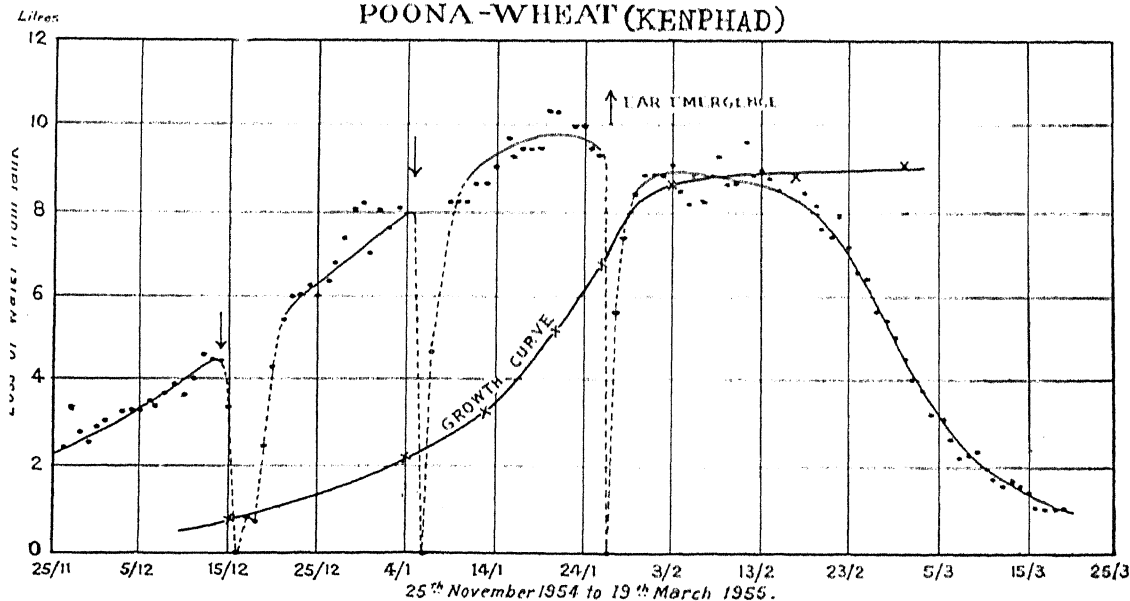
*Central Agricultural Meteorological Observatory, Poona*

STUDIES on the water requirements of crops are engaging the active attention of the workers at the Central Agricultural Meteorological Observatory, Poona, under the auspices of a scheme sanctioned by the Indian Council of Agricultural Research. The design of suitable experimental techniques for assessing the water lost by evapo-transpiration is now in progress. The present note is concerned with the results of a preliminary experiment conducted during November 1954 to March 1955, in the wheat crop. The experimental arrangements tried out, functioning somewhat similarly to those of Thornthwaite<sup>1</sup> are described briefly below:

A galvanised iron tank  $5' \times 5' \times 2\frac{1}{2}'$  was buried in the field with 3" of its rim projecting over the surface of the soil. The tank was connected by means of an underground G.I. pipe line to a float mechanism, which in turn was connected to a supply reservoir through a saddle valve so that a water-table could be maintained in the tank at a depth of 18" from the soil surface. The float mechanism had also an overflow arrangement to remove any excess water that tended to raise the water-table. Three such tank units were used and

the tanks were filled with soil so that the level of soil in the tanks and the field were the same. The tanks and field were planted with winter wheat crop. When the plants were one-week-old, each tank was irrigated from the top with an excess of water sufficient to cause an overflow and the overflow was collected and removed. As water was lost by evapo-transpiration, water from each supply reservoir moved into the respective field tank and daily readings of this loss was made. After 3 weeks' time, when the field was also being irrigated, each tank was irrigated with a known quantity of water sufficient to cause an overflow and the overflow was collected and measured. Any rain and the overflow from such rain during the interval between the two top irrigations were also recorded. The water requirement was given by the amount of water added to tank as top irrigation and any rain *plus* the amount of water lost from the supply reservoir *minus* the amount collected as overflow. Water requirement was estimated for 3-week intervals till the period of ear-emergence. Afterwards top irrigation was given only at the time of harvest to find out the water requirement for the period between ear-emergence and harvest. The

### EVAPO-TRANSPIRATION EXPERIMENT POONA-WHEAT (KENPHAD)



proton density distribution is different from the characteristic neutron density distribution for light elements.

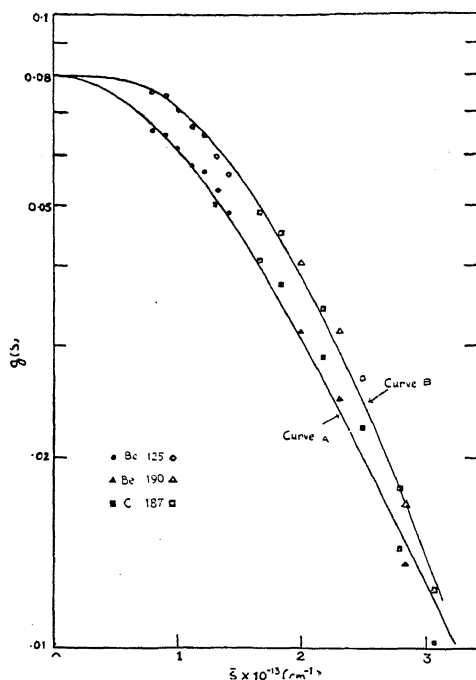


FIG. 1. Curve A represents theoretical  $g(\xi)$  while the full points represent the experimental  $g(\xi)$  normalized to it; Curve B represents experimental  $g(\xi)$  normalized to carbon data while the open points represent the experimental  $g(\xi)$  normalized to the same.

It may be noted that the form factor  $g(\xi)$  for a point nucleus would be represented by the constant value  $g(\xi) = 0.8$ . Any deviations of  $g(\xi)$  from this value must be regarded as due to the nature of the nuclear proton density distribution. It is clear that for small values of  $\xi$ ,  $g(\xi)$  of curve B deviates much less from this value than the  $g(\xi)$  of curve A. It may also be noted that, in the Born approximation,  $g(\xi)$  for small  $\xi$  arises from the characteristic nuclear proton density distribution at large distances from the centre of the nucleus. Therefore, one can conclude that the actual characteristic nuclear proton density distribution becomes negligible at smaller radial distances from the nuclear centre than the characteristic nuclear density distribution for neutrons. Therefore, the characteristic nuclear neutron density distribution predominates over the characteristic nuclear proton density distribution near the nuclear periphery. This conclusion agrees with that drawn by Johnson and Teller<sup>6</sup> on the basis of the

nuclear  $\beta$ -stability. However, the conclusion arrived at in the present investigation should be regarded as tentative until confirmed by further experimental data and their analysis.

Physics Dept., (Miss) M. K. ADVANI.  
Institute of Science, K. M. GATHA.  
Mayo Road, Bombay-1,  
December 13, 1955.

1. Hofstadter, R., Fechter, H. R. and McIntyre, J. A., *Phys. Rev.*, 1953, **92**, 978.
2. McIntyre, J. A., Hahn, B. and Hofstadter, R., *Ibid.*, 1954, **94**, 1084.
3. Advani, M. K., Shah, G. Z. and Gatha, K. M., *Curr. Sci.*, 1955, **24**, 367.
4. Gatha, K. M. and Shah, G. Z. (Private Communication).
5. Fregeau, J. H. and Hofstadter, R., *Phys. Rev.*, 1955, **99**, 1503.
6. Johnson, M. H. and Teller, E., *Ibid.*, 1954, **93**, 357.

### OCCURRENCE OF LIGNITIC MATERIAL IN THE GODAVARI DELTA

THE Government of Andhra have financed a project for the preliminary investigation of the occurrence of natural gas in parts of the Godavari Delta. Four bore-holes have been put down at Pedapatna Agraharam (150'), Vadrevupalle (100'), Amalapuram (200') and Thatipaka (325'), in the East Godavari District, between May and November 1955. Alternating layers of unconsolidated sand and clay were observed with occasional intercalations of partially decomposed vegetable matter. In the bore-hole at Thatipaka, blackish-brown fragments of low specific gravity (lighter than ordinary black clay) resembling peaty or lignitic material, were obtained at depths of 245' and 255'. The sample was analysed and the proximate analysis is given in column 1 of Table I. The usual range in composition of lignites, as specified by the U.S. Bureau of Mines, is also given alongside for comparison (col. 2).

TABLE I

	1	2
Moisture	.. 16.13%	23.20-40.00%
Volatiles	.. 40.05%	23.80-51.00%
Ash	.. 15.50%	4.20-15.80%
Fixed Carbon	.. 28.32%	20.90-35.00%

1. Analysis of Sample from Thatipaka, by T.V.S.R. Kshira Sagar. 2. Quoted from *Investigation of Preparation and Use of lignite*. U.S. Bureau of Mines, 1918-25, p. 86.

It can be seen from the table that the composition of the analysed sample falls well within the range of lignites but for the moisture content, which appears to be rather low. Detailed work on the nature of the sediments in the delta area is under progress.

The authors are grateful to Dr. V. S. Krishna for encouragement, to Professor C. Mahadevan and Dr. A. N. Rao for guidance and criticism and to Dr. M. N. Rao for help.

T. V. S. R. KSHIRA SAGAR.  
B. B. G. SARMA.

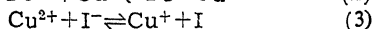
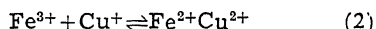
Dept. of Geology,  
Andhra University,  
Waltair, December 29, 1955.

### ON THE ESTIMATION OF IRON BY IODOMETRY

THE overall reaction involved in the estimation of iron by iodometry is represented by



A common practice<sup>1</sup> is to use suspensions of  $\text{Cu}_2\text{I}_2$  to catalyse the liberation of iodine. The use of this catalyst in effect provides an alternative mechanism in eliminating or modifying any of the steps suggested by Fudge and Sykes.<sup>2</sup> As a matter of fact, it can be noticed that on addition of a small quantity of  $\text{Cu}_2\text{I}_2$  to the solution of ferric salt, iodine is liberated and a transparent solution is obtained. Evidently the reactions



come into play. The full implication of reaction (2) in the ferric iodide reaction as well as in the oxidation of HI in the solution phase<sup>3</sup> will be published in due course.

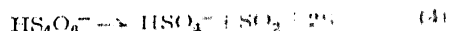
In spite of extensive investigation,<sup>4-8</sup> this method still presents difficulties preventing its wide application. We prescribe the conditions for an accurate estimation of iron present in solution as chloride, nitrate, perchlorate and even as sulphate, upto 0.3 molar concentration of  $\text{Fe}^{3+}$  having corresponding initial acid strength of 0.1N. Use of  $\text{HClO}_4$  has been recommended as  $\text{HNO}_3$  and  $\text{HCl}$  often contain impurities that affect the accuracy of the result. Complex formation with  $\text{Cl}^-$  and  $\text{SO}_4^{2-}$  ions do not affect the accuracy of the method. The reaction is complete within 2 minutes at room temperature. The necessity of using any catalyst or maintaining  $\text{CO}_2$  atmosphere does not arise.

In consideration of the observation of Kiss and Bossanyi<sup>9</sup> and the various side equilibria inherent in the system, we have so adjusted

the concentrations of  $\text{H}^+$  and  $\text{I}^-$  such that for a range of  $\text{Fe}^{3+}$  ion concentration iodometry can give satisfactory results.

To 25 c.c. of the solution of the ferric salt of strength ranging from 0.1-0.3 M containing initially 0.1N acid, 2 c.c. of 6N  $\text{HClO}_4$  and 4 g. of solid KI are to be added. The titration is to be carried out as usual with 0.1N  $\text{Na}_2\text{S}_2\text{O}_3$  solution using starch as indicator. The end point is sharp and after-bluing does not occur for days. For solutions of low  $\text{Fe}^{3+}$  content, the amount of solid KI should be maintained while 1 c.c. of acid is to be added and titration with 0.05N or 0.025N solution of  $\text{Na}_2\text{S}_2\text{O}_3$  as necessary may be carried out. After bluing of starch would not occur for at least 20 minutes, though the time allowed for the liberation of iodine is 2 minutes and that for titration 3-4 minutes.

The non-occurrence of after-bluing has been found to be dependent on the concentration of  $\text{HS}_4\text{O}_6^-$  which gives  $\text{SO}_2$  on decomposition. Of the following two reactions



We are of opinion that reaction (5) takes place predominantly in the presence of  $\text{Fe}^{2+}$  and HI in the system as sulphur does not appear in any considerable quantity. The formation of  $\text{SO}_2$  does not allow the appearance of after-bluing. With lapse of time, when the decomposition is either complete or the rate of aerial oxidation of  $\text{Fe}^{2+}$  and HI is greater as compared to the combined rate of reactions (4) and (5) that the after-bluing appears. The iodometric method of estimation entails various factors contributing to positive and negative errors,<sup>3</sup> but the procedure prescribed above gives results which are as accurate as obtained by dichromate method using N-phenyl anthranilic acid as indicator.

Dept. of Chemistry,  
Ravenshaw College,  
Cuttack-3,  
October 7, 1955.

D. PATNAIK,  
G. MAHAPATRA  
A. CHIRANJEYI

1. Vogel, A. I., *Text Book of Quantitative Analysis*, 1946 Edn., 436.
2. Fudge, A. J. and Sykes, K. W., *J. Chem. Soc.*, 1952, 119.
3. Patnaik, D. and others, to be published.
4. Hahn, F. and Windisch, H., *Ber.*, 1927, 56B, 566.
5. Kolthoff, I. M., *Pharm. Weekblad.*, 1921, 58, 1310.
6. Botzger, K. and Botzger, W., *Z. Anal. Chem.*, 1927, 70, 214.
7. Swift, E. H., *J. Amer. Chem. Soc.*, 1929, 51, 2667.
8. Grey, F. C., *J. Chem. Soc.*, 1929, 35.
9. Von Kiss, A. and Bossanyi, L., *Z. Amer. Chem.*, 1930, 191, 289.



types of turions are of the same size but it is observed that in the fully formed condition the length of green ones range from 3-12 mm. and the underground turions are generally larger in size and usually measuring from 4-15 mm. in length. The other distinguishing characters of these two types of turions have been given by Lakshmanan.<sup>2</sup>

When fully formed, the green turions drop on the bottom mud and the underground ones also get detached from the plant. In experimental earthenware tubs the turions were observed germinating within 8-12 days after being detached from the plant.

When shed, the green turions are generally found in the surface layers of the bottom soil and they germinate into small plants which are generally characterised by very short internodes with green, whorled leaves and roots (Fig. 1, C). Rarely, more than one shoot may

formed till the germinating shoot protrudes from the bottom mud and develops green leaves. Once the germination commences, it takes only about 12-14 days for the formation of a fully developed plant.

Both the turions are present on the plant in abundance during the period December-January. Detached turions were observed from the end of April onwards. Large-scale shedding of both the types of turions from the parent plants was observed from the beginning of May to the end of June. Almost all the turions are shed by the end of this period. In natural ponds, germination commences from the middle of May. Newly germinated plants are abundant in the pond by the middle of June.

As far as the author could make out, a large percentage of the newly developed plants results from the germination of both the types of turions. Whether seeds, if any, also play a significant role in tiding over adverse conditions and in the propagation of the plant is under investigation.

I am indebted to Mr. K. H. Alikunhi for helpful suggestion in this study.

Central Inland Fisheries Research Station,  
Calcutta-7, November 22, 1955.

EVA MITRA.

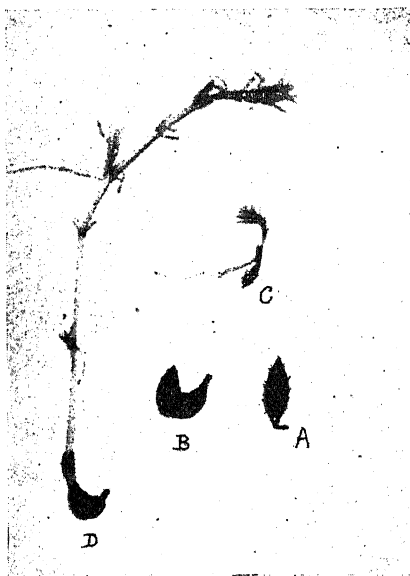


Fig. 1

A—Mature green turion.

B—Mature underground turion.

C—Germinating green turion with short internodes, green leaves and typical roots.

D—Germinating underground turion with long internodes and the roots developed at the point of emergence from the bottom mud.

also be seen coming out of a turion. The underground turions are found in the deeper layers of mud, even upto a depth of about 6-7". When the turions are buried deep, the germinating shoot elongates and bears long internodes and pale rudimentary leaves till it reaches the surface of the bottom mud (Fig. 1, D). Roots, which are adventitious, are also not ordinarily

1. Arber, A., *Water Plants*, Camb. Univ. Press, 1920, 219.
2. Lakshmanan, C., *J. Bom. Nat. Hist. Soc.*, 1951, 49 (4), 802.
3. Safeeulla, K. M. and Govindu, H. C., *Curr. Sci.*, 1949, 18 (ii), 414.
4. Mitra, Eva, *J. Asiatic Soc. Sci.* (in press).

#### RECORD OF THE BLACK BEETLE, *PHALACRUS IMMARGINATUS* CHAMP. FEEDING ON SUGARCANE SMUT

DURING August of this year, examination of smutted whips of sugarcane revealed the presence of a number of small holes in the membrane, and also of some black shining beetles which were briskly moving about. Subsequent studies showed that whitish grubs of different ages were concealed in the smut layer between the membrane and the columella of the smutted whip. As a result of their being embedded in the fertile layer, plenty of smut spores were seen attached to all parts of their body. Dissection of some of them showed the presence of spores (Fig. 1, A and B) in the alimentary system which suggested that the grubs feed on the spores. The spores collected from the alimentary canal appeared to be normal but failed to germinate when cultured artificially.

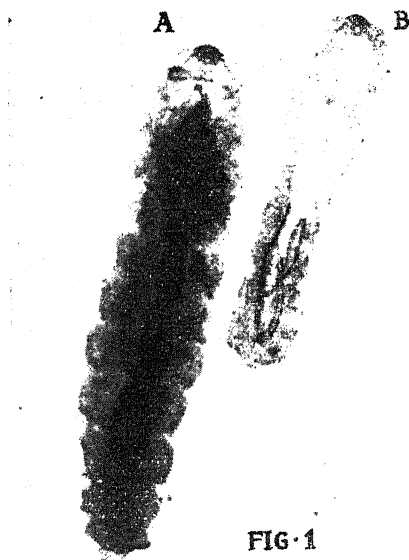


FIG. 1

FIG. 1. (A) A full grown grub (fore-intestine ruptured) with smut spores in the alimentary canal.  
(B) 3rd instar grub with some spores attached to its dorso posterior parts of the body.

A study of the life-history of the beetle was also made under laboratory conditions. The eggs are whitish and oblong when freshly laid, but turn brownish on hatching, measure 0.5-0.75 mm. long and 0.2-0.28 mm. broad. Eggs take 7 or 8 days to hatch. The grubs, on hatching, move about actively for some time and then enter the whip by puncturing the silvery membrane and establish themselves in the smutted layer, where they feed on the smut spores till they are fully grown. The fully grown grub is white in colour measuring 5.0-5.5 mm. in length and 1.3-1.5 mm. in breadth with three pairs of prolegs. When nearing pupation, the grubs descend and lodge themselves at the transverse mark, i.e., at the junction of the leaf with the stem. They cease to feed, and remain quiescent for a time before pupating. The pupa is white in colour, 2.8-3.3 mm. long and 1.5-1.7 mm. broad, broader at the anterior end. The pupal period, as observed in the laboratory, varies from 8-9 days. The adults, when freshly emerged are brownish white and inactive, but turn into shining black beetles after some time. The adult is convex, 2.5-3.5 mm. long and 1.5-2.3 mm. broad. The antennae are clavate and 11-segmented. Tarsus 4-jointed with a

pair of claws. The elytra covers the abdomen entirely.

This is presumably the first record of the occurrence of *Phalacrus immarginatus* Champ. on sugarcane smut. Grateful thanks are due to Shri N. L. Dutt for his guidance and encouragement. The author is indebted to Dr. M. L. Roonwal (Dehra Dun), for kindly identifying the insect.

Sugarcane Breeding Inst., R. A. AGARWAL.  
Coimbatore, October 10, 1955.

### EFFECT OF HORMONES ON GERMINATION IN LOQUAT POLLEN

In the course of his studies on parthenocarpy in loquat (*Eriobotrya japonica*) the author observed very poor setting in the flowers borne in the months of August and September. The production of pollen was also found to be poor in those months. It was therefore considered desirable to find if the germination of pollen and the elongation of the pollen tube could be accelerated with the help of growth substances.

The freshly-collected pollen were germinated in 1% sugar solution on cavity slides and, where necessary, the growth substances were applied in that medium. The slides were sealed with liquid paraffin, so that they could be easily opened and sealed. The germination of the pollen was allowed to continue only for 90 minutes and the observations were made at 30 minutes interval. In the end a drop of acetocarmine was introduced in the culture drop for staining and killing the tubes.

Germination of pollen was recorded by counting the total number of pollen in a field and then recording the number of germinated pollen in the same field. Figures in tables indicate the values obtained from observations in four fields. The length of the pollen tube was measured with the help of a standardised

#### I. EFFECT OF NAPHTHALENE ACETIC ACID

TABLE I

Effect of alpha naphthalene acetic acid on germination of pollen and the elongation of the pollen tube

Concentration p.p.m.	Time in mt. for germination	Percentage of germination	Length of pollen tube
0	67	32.5	3.07
5	68	36.3	3.32
10	67	26.0	2.97
15	90	7.2	..

# EQUILIBRIUM CONFIGURATIONS OF OBLATE FLUID SPHEROIDS UNDER THE INFLUENCE OF MAGNETIC FIELD

S. P. TALWAR

Dept. of Physics, University of Delhi, Delhi

RECENTLY G. Gjellestad<sup>1</sup> discussed the equilibrium configurations of gravitating incompressible fluid spheroids (homogeneous, inviscid and infinitely conducting) subject to a uniform magnetic field  $H$  inside and a dipole field outside. However, in her paper the sign of the integral in the first part of the equation (65) is incorrect. We give, in this note, the results of a more general study of the problem of the equilibrium of *oblate fluid spheroids* in the presence of a magnetic field which is assumed to be described by

(i) a uniform field  $H$  inside the spheroid in the  $z$ -direction, and

(ii) an external field made up of a uniform field  $kH$  along the  $z$ -direction and that due to a dipole of moment  $(1-k) \frac{H(1+E^2)^{\frac{1}{2}}}{Q_1^1(iE)}$  (the axis of the dipole being parallel to the  $z$ -direction) in order to make the normal component of the field continuous on the surface of the spheroid. Here  $E$  gives the boundary of the spheroid and the function  $Q_1^1(iE)$  is defined as

$$Q_1^1(iE) = (1+E^2)^{\frac{1}{2}} \frac{dQ_1(iE)}{dE}$$

$Q_1(iE)$  being the Legendre function of the second kind.

If we take  $k=0$ , we get a spheroid with a uniform magnetic field inside and a dipole field outside. This case is the same as that discussed by G. Gjellestad. But due to the inconsistency mentioned above, our subsequent results for the case  $k=0$  are different. The case  $k=1$  corresponds to a uniform field of the same value both inside and outside the spheroid. If we let  $k \rightarrow \infty$ ,  $H \rightarrow 0$  but  $kH = H_0$  remaining finite, it corresponds to an oblate spheroid under only an external field made up of a uniform field  $H$  in the  $z$ -direction superposed by a field due to a dipole of moment  $\frac{H_0(1+E^2)^{\frac{1}{2}}}{Q_1^1(iE)}$  in the antiparallel direction.

Under the influence of magnetic field of the characteristics mentioned above, we find that there exists a sequence of gravitating oblate fluid spheroids.

The spheroids are assumed to be infinitely conducting, incompressible non-rotating and situated in infinite empty space. Following G. Gjellestad we have used oblate spheroidal

co-ordinates which are defined in terms of the triple infinity of orthogonal surfaces provided by the confocal spheroids

$$\frac{x^2+y^2}{1+\xi^2} + \frac{z^2}{\xi^2} = c^2 \quad (0 \leq \xi < \infty)$$

the confocal hyperboloids

$$\frac{x^2+y^2}{1-\mu^2} - \frac{z^2}{\mu^2} = c^2 \quad (-1 \leq \mu \leq +1)$$

and the planes  $\phi = \text{constant}$  ( $0 \leq \phi \leq 2\pi$ ) through the  $Z$ -axis. Here  $c$  is a constant equal to half the distance between the foci.

We investigate the stability of an oblate spheroid of boundary given by

$$\xi = E$$

by subjecting it to a general  $P_n$  deformation so that its boundary changes to one given by

$$\xi = E + \epsilon \frac{1+E^2}{E^2+\mu^2} P_n(\mu) \quad (n > 0)$$

where  $\epsilon$  is a non-dimensional constant.

Because of the deformation (5), there shall be a change  $\Delta Q$  in the gravitational potential energy of the spheroid and a change  $\Delta m$  in the total magnetic energy, which consists of two parts—the change,  $\Delta m^{(i)}$  in the magnetic energy inside the spheroid and the change,  $\Delta m^{(e)}$  in the external magnetic energy. We then employ the equilibrium condition

$$\Delta Q + \Delta m = 0$$

in order to define the equilibrium spheroids.

We find that the total change,  $\Delta m$ , in the magnetic energy vanishes for odd values of  $n$ , whereas it is of the order  $\epsilon$  for all even ( $2n$ ) deformations, and is given by

$$\Delta m_{2n} = - \frac{H^2 c^3 (1+E^2)}{Q_1^1(iE)} \sum_{n=1}^{\infty} \left\{ \frac{(1-k)}{P_{2n}^1(iE)} - \frac{(1-k) \left(1 + \frac{k}{3}\right)}{4 [Q_1^1(iE)]} \int_{-1}^{+1} \frac{P_{2n}(\mu)}{E^2 + \mu^2} d\mu \right\} \epsilon_{2n}$$

where  $P_{2n}^1(iE)$  are defined as

$$P_{2n}^1(iE) = (1+E^2)^{\frac{1}{2}} \frac{dP_{2n}(iE)}{dE}$$

The functions  $P_{2n}(iE)$  denote the Legendre functions of the first kind.

The expression for the change,  $\Delta Q$  in the gravitational potential energy of a spheroid as derived by G. Gjellestad, is

$$\Omega = \frac{3}{10} \frac{M^2 G}{c^2} \left[ \frac{1}{1-e^2} \cot^{-1} \left( \frac{1}{1-e^2} \right) - 3 \right] \quad (9)$$

where  $M$  denotes the mass of the spheroid. The change in the gravitational potential energy of the spheroid is of the first order in  $e$  only for a P<sub>1</sub> deformation and of higher order for all higher order deformations.

For a P<sub>1</sub> deformation of the spheroid, for which both  $\Delta m$  and  $\Omega$  are of the order  $e$ , the condition

$$\Omega - \Delta m = 0$$

for equilibrium gives that a configuration is stable for P<sub>1</sub> deformation if

$$H > H_{eq} \left[ \frac{f(e)}{e^2 F_2(e)} \right]^{\frac{1}{2}} \quad (10)$$

where, for convenience, we have put

$$H_{eq} = \sqrt{\frac{3}{10} \frac{M^2 G}{a^3}}$$

$a$ , being the major half-axis of the spheroid, and  $G$  the constant of gravitation.

Here the functions  $f(e)$  and  $F_2(e)$  are defined as

$$f(e) = \frac{3}{e} \left[ \frac{2}{1-e^2} \cot^{-1} \left( \frac{1}{1-e^2} \right) - 3 \right] \quad (11)$$

and

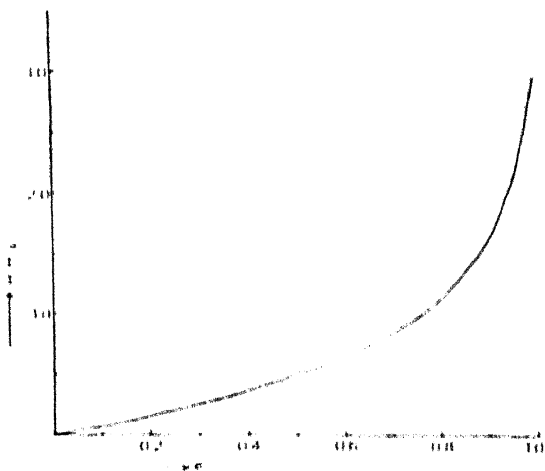


FIG. 1

$$F_2(e) = \frac{e^2 \left( 1 - \frac{k}{3} \right)}{3(1-e^2)Q_1^2(e)} - \frac{(1-k) \left( 1 - \frac{k}{3} \right)}{4[Q_1^2(e)]^{\frac{3}{2}}} \quad (12)$$

( $e$  denotes the eccentricity of the spheroid).

The function  $H/H_{eq}$  is plotted against  $e$  for the case  $k=0$  in Fig. 1, and for the other two cases in Fig. 2. We find that  $H/H_{eq}$  increases with increase in the eccentricity for the three types of magnetic field discussed.

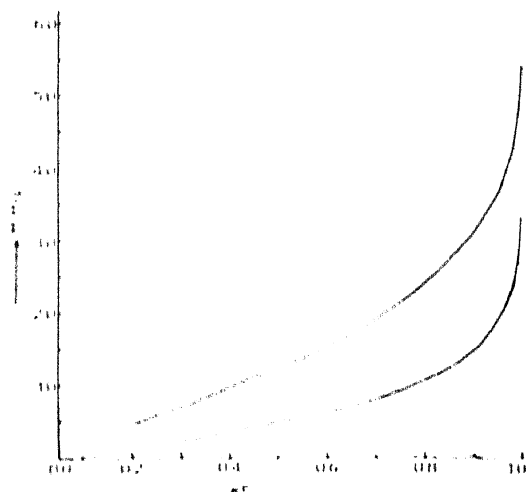


FIG. 2

However,  $H/H_{eq}$  required for stability of the spheroid is more for the case when  $k \rightarrow \infty$ ,  $H \rightarrow 0$  but  $kH$  remaining finite ( $H_0$ ). Thus we find that there exists a unique configuration for a spheroid which is stable for a P<sub>1</sub> deformation for each of the three types of magnetic field under consideration.

The detailed paper shall be published elsewhere.

The author is highly indebted to Prof. D. S. Kothari and to Prof. F. C. Auluck for helpful discussion and constant encouragement.

L. Guro Gjeltestad, *Astrophys. J.*, 1954, **119**, 14.

### LADY TATA SCIENTIFIC RESEARCH SCHOLARSHIPS, 1956-57

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1956-57 commencing from 1st July 1956. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of a scientist of standing in a recognised research institute or laboratory

on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trust and should reach by March 15, 1956. Candidates can obtain these instructions and other information they desire from the Secretary, the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay-1.

in a recent judgment in Canada, against a defendant accused of falsifying the registration of pure-bred cattle, points to its infallibility in the legal sense as in human cases.

I. J. Cunningham discusses "Diseases Caused by Deficiencies of Trace Elements", and control measures on a national scale as cobalt and copper deficiencies are of wide occurrence throughout the world.

N. T. Clare writes on "Photosensitization in Animals", in which 23 plant poisonings and other conditions which affect livestock, are discussed. Fifteen of these are classified as hepatogenous photosensitivity.

"Rumen Dysfunction" is dealt at length by A. T. Phillipson. The physiology of the alimentary tract is discussed in the broadest sense to include the microbiological and biochemical events of the stomach and gut in the young suckling as well as adult ruminants.

J. C. Shaw describes "Bovine Ketosis" in detail, with reference to incidence, etiology, diagnosis and therapy. "Tickborne Rickettsioses in South Africa" by D. A. Haig, and "Vibriosis" by W. N. Plastring, summarize the principal advances in these subjects.

"Effective Control of Internal Parasites", the final essay, is written by Donald C. Boughton, who concludes, "The prime motivation for undertaking parasitic control is the profit to be derived therefrom".

The well authenticated references under each chapter, the classified author and subject index at the end add value to the work. Further volumes in the series will be eagerly awaited.

V. MAHADEVAN.

#### Some Beautiful Indian Trees. Second Edition.

By E. Blatter, W. S. Millard and W. T. Stearn. (Bombay Natural History Society, Bombay), 1954. Pp. xv + 165. Price Rs. 20 or 30 sh.

#### Some Beautiful Indian Climbers and Shrubs.

By N. L. Bor and M. B. Raizada. (Bombay Natural History Society, Bombay), 1954. Pp. viii + 286. Price Rs. 22.

These two delightfully published books with fascinating colour plates and half-tone reproductions have to be welcomed by the amateur botanist, or, shall I say, the amateur naturalist and the serious-minded professional. The word 'amateur naturalist' has somewhat partially, if not wholly, lost its meaning in Modern India. In the frightful craze for more and more specialisation in narrower and narrower fields

and with the advent of application of physical sciences in interpreting biological norm, the fashion of the day is a relentless and ruthless derivation of formulæ and equations. Against this outlook it is most pleasing to read through the decorative and colourful pages of these two volumes which together open a new field to naturalists in India, not only of emulating these publications and bringing out similar descriptive keys to our floras but also to acquire common field knowledge of the trees and shrubs around us.

The first book is written in very popular style with description followed by details of distribution, flowering season, gardening notes, uses and vernacular names. While considering whole genera, a key is given which would help in distinguishing the various species. The appendices would be found very useful as they include: descriptions of families represented; key to genera described; changes in nomenclature; glossary of some botanical terms and finally, a useful index. The printing and get-up of this book is better as it has been printed by the very experienced printers, Oliver & Boyd.

The second book satisfies the needs of the keen amateur gardener as well as a student of botany. It has a fairly comprehensive key to the species described in addition to a good description of the genus. A very useful glossary of the botanical terms used and an index of scientific terms terminates the book. The colour plates are excellent and life-like although the printing of the text is not all that is to be desired.

In my opinion the popularity of these two publications should be second to none both in our colleges and future upgraded High Schools and in the personal libraries of lovers of nature. To those who feel that the Linnaean age has given place to an experimental one, these books would serve as a reminder to the immense pleasure that both the amateur and the experimentalist can derive from a study of the floras around them with these splendid twin companions by their side.

T. S. SADASIVAN.

**Inorganic Nitrogen Metabolism.** (*Function of Metallo-Flavoproteins—A Symposium.*) Edited by W. D. McElroy and Bentley Glass. (The Johns Hopkins Press, Baltimore), 1956. Pp. xiii + 728. Price \$10.00.

There are few subjects of specialisation in biology that have gripped the biologist, biochemist, physical chemist and physicist, not to

rotaries of the new hybrid discipline of chemistry and biogeochemistry as the nitrogen metabolism of micro-plants and animals. From small, almost obscure beginnings in the of the nineteenth century, the subject has come to be regarded, as more and more science accrues, as a physico-chemical process. Key heavy metals like molybdenum are part in both nitrogen assimilation and denitrification because of their general function in nitrogen transport. This symposium organised by the McCollum-Pratt Institute of the Johns Hopkins University is probably one of the most carefully and carefully planned ones that has come across. The major topics are: Role of molybdenum in plant nitrogen metabolism; Nitrate and nitrite metabolism by micro-organisms; General physiology of nitrification and denitrification; Nitrogen fixation; Comparative aspects of ammonia metabolism; Metabolic relationship between nitrogen and other metals—Function of nitrogen in proteins; Summary (a splendid survey by Bentley Glass); Author index. These chapters summarise the data presented by the many par-

It is obvious from this symposium: that the study of nitrogen metabolism centres on the same systems as they fit into basic processes in micro-organisms, plants and animals. Fundamental pathways of physiological and nutritional processes are very similar and, of course, the same pathways are abundant as well as intermediates and these could in some cases be altered either through genetic adaptations or through the action of the various prosthetic groups. Modern techniques have been used in the presentation and it serves to emphasise the need for selfless team work. I say this because the conceivable physical instrument has been successfully employed especially in the use of the photochromic c using double beam retrophotometers, and in the case of the analysis of gases evolved in anaerobic respiration the use of mass spectrometers. And the most interesting chapter is dealing with hydrogenase-nitrogenase of *Desulfohalobium pasteurianum* which has been shown to have hydrogenase and cell-free extracts of this organism which have been shown to be disintegrated were purified. This hydrogenase system is

able to utilise electron acceptor and is quickly inactivated by exposures to oxygen, carbon monoxide and nitric oxide. It has been pointed out that from the similarity of the nitrogenase and hydrogenase systems, nitrogen might be chemisorbed by the metal of the nitrogenase and then be reduced by the hydrogenase.

Certain major points that have emerged from this symposium: that nitrate like molecular nitrogen itself, constitutes a terminal pool which may be drawn upon by organisms; that hydroxylamine occupies a key position in nitrogen assimilation and synthesis of amino acids from inorganic matter and that molybdenum plays as important a role in the nitrogen cycle as iron in respiration and magnesium in photosynthesis.

I warmly commend the volume to all physiologists (of course, including biochemists and biophysicists engaged in border-line problems), for it is excellently edited, has an exhaustive bibliography and stimulating discussions at the end of each chapter by leading men in different fields of research collectively termed: General Physiology.

T. S. SADASIVAN.

#### Books Received

- Neuro-Otology.* (*British Medical Bulletin*, 1956, Vol. 12, No. 2, pp. 91-160.) (Agents in India: Oxford University Press.) Price 15 sh.
- Anuario Estatístico do Brasil*, 1955. (IBGE, Conselho Nacional De Estatística), 1956. Pp. xxxi + 639.
- The Distribution of the Standing Crop of Zooplankton in the Southern Ocean.* By P. Foxton. (Cambridge University Press.) *Discovery Reports*, Vol. XXVIII, 1956. Pp. 193-235. Price 7 sh. 6 d.
- Modern Methods of Plant Analysis*, Vol. I. Edited by K. Paech and M. V. Tracy. (Springer-Verlag, Berlin), 1956. Pp. xvii + 542. Price DM 108.
- Trace Elements in Human and Animal Nutrition.* By E. J. Underwood. (Academic Press), 1956. Pp. vii + 430. Price \$9.50.
- Automation—Friend or Foe?* By R. H. Macmillan. (Cambridge University Press), 1956. Pp. vii + 100. Price 8 sh. 6 d.
- Fertilization.* By Lord Rothschild. (Methuen, London, W.C. 2), 1956. Pp. ix + 170. Price 18 sh.

contain not less than 2% of that element. But the demand that has been created after the discovery of atomic energy makes it now worthwhile to mine and process an ore containing only 0.1% uranium.

As is well known, only a few limited areas in the world have been searched intensively for minerals. Such areas are to be found around the North Atlantic, *viz.*, in Western Europe and North America. In other parts of the world, only a few small areas have been examined in detail. The greater part of South America, Africa and Asia remain to be explored with care. In Asia and Africa there are regions which have not yet been mapped geologically. Under the circumstances, it is reasonable to expect that intensive exploration and prospecting would lead to the discovery of a number of mineral deposits of which some at least would be of importance.

In all countries, early in the process of industrialisation only the richest deposits exposed at the surface were worked and utilised locally or exported. Much wastage occurred at this stage. This was soon followed by industrial development marked by the setting up of metallurgical, chemical and engineering works. The national wealth and prosperity of a country increased during this stage. The third stage is a period of depletion of cheap domestic mineral resources and import of raw materials from outside for feeding local industries. Thereafter comes the stage of having to depend on foreign ore and other raw materials, leading gradually to the loss of competitive power in foreign markets, due to the necessity for purchase of much of the raw material requirements from outside.

India is just passing through the first stage and entering the second. The further stages could be strengthened by careful husbanding of the resources by the adoption of conservation measures. An outstanding example in India, requiring the enforcement of conservation, to which repeated attention has been called, is the misuse of good coking coal for burning in boilers and locomotives for steam raising, for which non-coking coal of a similar grade would do quite well. It is only during the last four or five years that serious steps have been taken to prevent the objectionable use of coking coal.

Conservation has to be effected at all stages of the development of the mineral deposits, in mining, milling and ultimate utilisation. All technological advances in any of these stages automatically bring in improvements which are conducive to conservation. Conservation

is also achieved by substituting a more easily available and cheaper material for one which is costly or difficult to get. Substitution is often dictated by necessity, and will be acceptable so long as the easily available substitute is good enough for the purpose for which it is intended. Thus, though it may be worthwhile using a good grade of mica for all types of electrical insulation, a poorer insulator would serve for some purposes. Mica substitutes are, therefore, coming into use in the countries which have to import this mineral in large quantities.

It is an interesting fact that no mineral has become entirely obsolete and unusable. The pattern of use may change occasionally, but so long as a mineral finds some use, it continues to be employed until it is replaced by something more suitable or is used for some other special purpose. A good example is afforded by monazite for which the black sands of the Travancore coast were originally worked. It was then employed for the requirements of the gas mantle industry. But, after the First World War, the demand for the mineral fell and practically stopped, as gas had largely been replaced by electricity for lighting in Europe. In the meanwhile, ilmenite which is associated with the monazite, found use in the manufacture of a paint pigment—titanium white. This mineral rapidly assumed importance and monazite was nearly forgotten for a while. But during and after the Second World War, monazite has again attained prominence as a possible source of atomic energy because of its content of appreciable amounts of thorium and a little uranium. Ilmenite also continues to be utilised, so that at present there is a good demand for both these minerals.

The latest prophecy seems to be that atomic energy is going to make coal an unwanted material and that coal mining will be a thing of the past within a decade. But we may well ask whether all the uranium needed for bringing about such a complete revolution in the industrial set-up and power production will be available (as also other materials needed for regulation and control of the nuclear reactions) at a price which will compete seriously with coal. Similar prophecies were made about coal when large developments in the production of petroleum as well as of hydro-electricity took place three or four decades ago. There are as yet no signs of coal becoming unnecessary to mine.

Our present knowledge goes to show that we have only a few surpluses and quite considerable deficiencies in the list of useful mine-

needed for industry. There is a sufficiency plus in coal, ores of iron, manganese, aluminium, titanium, chromium, magnesium; garnets, kyanite, sillimanite and various kinds of clays. The chief deficiencies are in lead, zinc, silver, nickel, cobalt, molybdenum, tungsten, tin, antimony and mercury for the metals; and sulphur, phosphates, oil, petroleum, potash, graphite, asbestos amongst the non-metallic minerals. In every case our knowledge is confined to observations. We do not know enough of what lies below the surface even at great depths. There is, consequently, a chance of finding good some of the deficiencies by a more and intensive search in suitable areas. During the last few years has the Geo-

logical Survey been strengthened suitably in personnel and equipment to face this task adequately. A Bureau of Mines has been established to look after the work of improving the techniques and standard of mining and enforcing mineral conservation measures. An Oil and Natural Gas Division is being set up to undertake systematic and intensive exploration for petroleum. Within the Geological Survey itself there are specialist wings to study Mineral Deposits, Groundwater and Engineering Geology and to conduct Geophysical Exploration. The co-ordinated efforts of all these will be directed towards the study of all the phases of exploration and development of our resources in minerals, and will contribute steadily to the building up of a strong and prosperous nation.

### FIRST CONGRESS ON THEORETICAL AND APPLIED MECHANICS

First Congress on Theoretical and Applied Mechanics was held on the 1st and 2nd December 1955, at the Indian Institute of Technology, Kharagpur, under the Presidentship of Dr. K. S. Krishnan, Director, National Physical Laboratory, New Delhi. Of the 147 persons who registered themselves as members, 111 participated in the deliberations of the Congress. Fifty-two papers were read and followed by lively discussion. Messages of welcome were received from a number of distinguished workers all over the world.

Dr. Sen Gupta, Chairman of the Organising Committee, stressed the need for both theoretical and experimental approaches to any problem of mechanics and advocated a harmonising of the two. This was followed by the Presidential Address on 'The Physics of Filaments in Vacuum'. The theory was expounded by Dr. Krishnan knits into a single thread the uncorrelated empirical results obtained by various experimenters.

Dr. Sen Gupta gave a half-hour address by Prof. N. S. on 'Some Formulæ in Meteorological Dynamics'. He showed how with the help of a formulae formulated by him and Kolmogoroff, a forecast for multiple prediction may be devised by making use of phase averages or time series. Other addresses were by L. E. Payne on 'Class of Problems in Plane Elasticity' and V. M. Ghatage on 'Ring Aerofoils and Possible Use'. Dr. Payne showed how the problem of semi-infinite elastic medium on an infinite strip the use of dual integral transforms may be avoided by a suitable definition of Airy's stress function. Dr. Gha-

tage indicated an interesting arrangement of a ring aerofoil and a source which could climb in the vertical direction without any horizontal race on the ground, and could also move backward or forward. Though a practical design of this type had not been worked out, it was quite feasible and deserved thought and consideration. A majority of the papers presented at the Congress dealt with problems on elasticity and plasticity. Among the other topics discussed were fluid mechanics, callistics, vibrations, thermodynamics, statistics and mathematical physics.

An *ad hoc* meeting was held for the formation of the Indian Society of Theoretical and Applied Mechanics. The following office-bearers were elected: Dr. K. S. Krishnan (*President*), Dr. V. M. Ghatage and Prof. N. R. Sen (*Vice-Presidents*), Prof. B. R. Seth (*Secretary-Treasurer*).

The First Congress on Theoretical and Applied Mechanics has served a useful purpose in bringing together workers in engineering science from all parts of India, and emphasising the need for producing engineer-scientists along with the establishment of colleges for producing working engineers. It may be essential for this purpose to enrol brilliant graduates from Indian Universities with high academic distinctions in basic sciences like applied mathematics, physics, chemistry, geology, geophysics and statistics, and engage them in research work in theoretical and applied mechanics and other basic subjects on which the science of engineering is built up.



# EQUILIBRIUM CONFIGURATIONS OF OBLATE FLUID SPHEROIDS UNDER THE INFLUENCE OF MAGNETIC FIELD

S. P. TALWAR

Dept. of Physics, University of Delhi, Delhi

RECENTLY G. Gjellestad<sup>1</sup> discussed the equilibrium configurations of gravitating incompressible fluid spheroids (homogeneous, inviscid and infinitely conducting) subject to a uniform magnetic field  $H$  inside and a dipole field outside. However, in her paper the sign of the integral in the first part of the equation (65) is incorrect. We give, in this note, the results of a more general study of the problem of the equilibrium of *oblate fluid spheroids* in the presence of a magnetic field which is assumed to be described by

(i) a uniform field  $H$  inside the spheroid in the  $z$ -direction, and

(ii) an external field made up of a uniform field  $kH$  along the  $z$ -direction and that due to a dipole of moment  $(1-k) \frac{H(1+E^2)^{\frac{1}{2}}}{Q_1^1(iE)}$  (the axis of the dipole being parallel to the  $z$ -direction) in order to make the normal component of the field continuous on the surface of the spheroid. Here  $E$  gives the boundary of the spheroid and the function  $Q_1^1(iE)$  is defined as

$$Q_1^1(iE) = (1+E^2)^{\frac{1}{2}} \frac{dQ_1(iE)}{dE}$$

$Q_1(iE)$  being the Legendre function of the second kind.

If we take  $k=0$ , we get a spheroid with a uniform magnetic field inside and a dipole field outside. This case is the same as that discussed by G. Gjellestad. But due to the inconsistency mentioned above, our subsequent results for the case  $k=0$  are different. The case  $k=1$  corresponds to a uniform field of the same value both inside and outside the spheroid. If we let  $k \rightarrow \infty$ ,  $H \rightarrow 0$  but  $kH = H_0$  remaining finite, it corresponds to an oblate spheroid under only an external field made up of a uniform field  $H$  in the  $z$ -direction superposed by a field due to a dipole of moment  $\frac{H_0(1+E^2)^{\frac{1}{2}}}{Q_1^1(iE)}$  in the antiparallel direction.

Under the influence of magnetic field of the characteristics mentioned above, we find that there exists a sequence of gravitating oblate fluid spheroids.

The spheroids are assumed to be infinitely conducting, incompressible non-rotating and situated in infinite empty space. Following G. Gjellestad we have used oblate spheroidal

co-ordinates which are defined in terms of the triple infinity of orthogonal surfaces provided by the confocal spheroids

$$\frac{x^2+y^2}{1+\xi^2} + \frac{z^2}{\xi^2} = c^2 \quad (0 \leq \xi \leq \infty) \quad (1)$$

the confocal hyperboloids

$$\frac{x^2+y^2}{1-\mu^2} - \frac{z^2}{\mu^2} = c^2 \quad (-1 \leq \mu \leq +1) \quad (2)$$

and the planes  $\phi = \text{constant}$  ( $0 \leq \phi \leq 2\pi$ ) (3) through the  $Z$ -axis. Here  $c$  is a constant equal to half the distance between the foci.

We investigate the stability of an oblate spheroid of boundary given by

$$\xi = E \quad (4)$$

by subjecting it to a general  $P_n$  deformation so that its boundary changes to one given by

$$\xi = E + \epsilon \frac{1+E^2}{E^2+\mu^2} P_n(\mu) \quad (n > 0) \quad (5)$$

where  $\epsilon$  is a non-dimensional constant.

Because of the deformation (5), there shall be a change  $\Delta Q$  in the gravitational potential energy of the spheroid and a change  $\Delta m$  in the total magnetic energy, which consists of two parts—the change,  $\Delta m^{(i)}$  in the magnetic energy inside the spheroid and the change,  $\Delta m^{(e)}$  in the external magnetic energy. We then employ the equilibrium condition

$$\Delta Q + \Delta m = 0 \quad (6)$$

in order to define the equilibrium spheroids.

We find that the total change,  $\Delta m$ , in the magnetic energy vanishes for odd values of  $n$ , whereas it is of the order  $\epsilon$  for all even ( $P_{2n}$ ) deformations, and is given by

$$\begin{aligned} \Delta m_{2n} = & - \frac{H^2 c^3 (1+E^2)}{Q_1^1(iE)} \sum_{n=1}^{\infty} \left\{ \frac{(1-k)}{P_{2n}^1(iE)} \right. \\ & \left. - \frac{(1-k) \left(1 + \frac{k}{3}\right)}{4 [Q_1^1(iE)]} \int_{-1}^{+1} \frac{P_{2n}(\mu)}{E^2 + \mu^2} d\mu \right\} \epsilon_{2n} \quad (7) \end{aligned}$$

where  $P_{2n}^1(iE)$  are defined as

$$P_{2n}^1(iE) = (1+E^2)^{\frac{1}{2}} \frac{dP_{2n}(iE)}{dE} \quad (8)$$

The functions  $P_{2n}(iE)$  denote the Legendre functions of the first kind.

The expression for the change,  $\Delta Q$  in the gravitational potential energy of a spheroid as derived by G. Gjellestad, is

$$\Delta\Omega = -\frac{3}{10} \frac{M^2 G}{c} \epsilon_2 \left[ \frac{3E^2+1}{E} \cot^{-1} E - 3 \right] \quad (9)$$

where  $M$  denotes the mass of the spheroid. The change in the gravitational potential energy of the spheroid is of the first order in  $\epsilon$  only for a  $P_2$  deformation and of higher order for all higher order deformations.

For a  $P_2$  deformation of the spheroid, for which both  $\Delta m$  and  $\Delta\Omega$  are of the order  $\epsilon$ , the condition

$$\Delta\Omega + \Delta m = 0$$

for equilibrium gives that a configuration is stable for  $P_2$  deformation if

$$H = H_{eq.} \left[ \frac{f(e)}{e^2 F_2(e)} \right]^{\frac{1}{2}} \quad (10)$$

where, for convenience, we have put

$$H_{eq.} = \sqrt{\frac{3}{10}} \frac{M\sqrt{G}}{a^2}$$

$a$ , being the major half-axis of the spheroid, and  $G$  the constant of gravitation.

Here the functions  $f(e)$  and  $F_2(e)$  are defined as

$$f(e) = \frac{3-2e^2}{e(1-e^2)^{\frac{1}{2}}} \cot^{-1} \left( \frac{1-e^2}{e^2} \right)^{\frac{1}{2}} - 3 \quad (11)$$

and

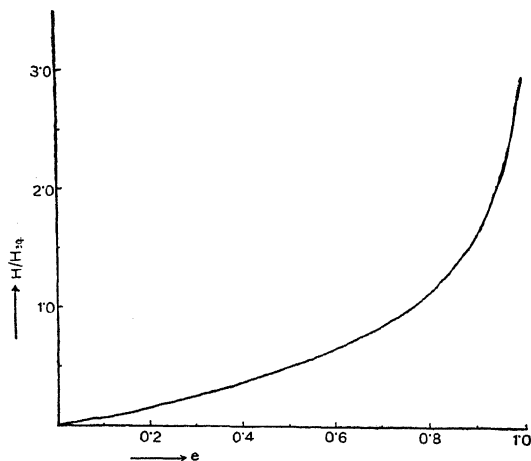


FIG. 1

$$F_2(e) = \frac{e^2 \left(1 - \frac{k}{3}\right)}{3(1-e^2)^{\frac{1}{2}} Q_1'(iE)} - \frac{(1-k) \left(1 + \frac{k}{3}\right)}{4 [Q_1'(iE)]^2} f(e) \quad (12)$$

( $e$  denotes the eccentricity of the spheroid).

The function  $H/H_{eq.}$  is plotted against  $e$  for the case  $k=0$  in Fig. 1, and for the other two cases in Fig. 2. We find that  $H/H_{eq.}$  increases with increase in the eccentricity for the three types of magnetic field discussed.

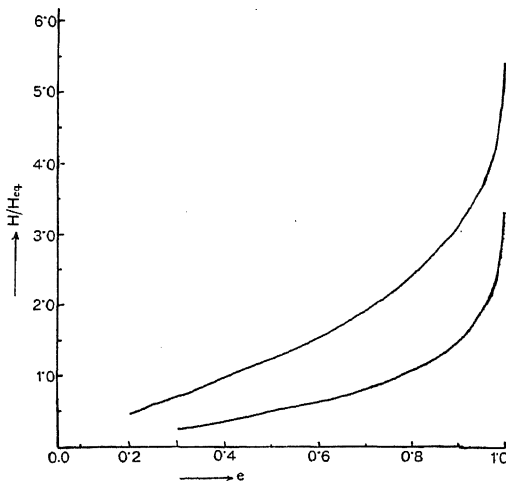


FIG. 2

However,  $H/H_{eq.}$  required for stability of the spheroid is more for the case when  $k \rightarrow \infty$ ,  $H \rightarrow 0$  but  $kH$  remaining finite ( $= H_0$ ). Thus we find that there exists a unique configuration for a spheroid which is stable for a  $P_2$  deformation for each of the three types of magnetic field under consideration.

The detailed paper shall be published elsewhere.

The author is highly indebted to Prof. D. S. Kothari and to Prof. F. C. Auluck for helpful discussion and constant encouragement.

1. Guro Gjellestad, *Astrophys. J.*, 1954, 119, 14.

#### LADY TATA SCIENTIFIC RESEARCH SCHOLARSHIPS, 1956-57

THE Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1956-57 commencing from 1st July 1956. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of a scientist of standing in a recognised research institute or laboratory

on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trust and should reach by March 15, 1956. Candidates can obtain these instructions and other information they desire from the Secretary, the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay-1.

	PAGE		PAGE
Vitamins, Recent Research on (Rev.) ..	205	XANTHOMONAS, Three Undescribed Species of .. ..	366
Vitexin frn <i>Vitex peduncularis</i> Wall ..	328	X-Ray Diffraction in Polycrystalline Materials (Rev.) .. ..	30
WASTE Heat from Nuclear Reactors, Use of .. ..	101	YEAST, Relation between the Nucleus and the Vacuole .. ..	397
Water Requirements of Crops, Apparatus for ..	250	ZONATE Leaf-Spot Disease of Jowar ..	137
— — of Wheat: Variety Kenphad, ..	179	Zoological Society of India ..	208
for Determination of .. ..	250		
Water-Masses in the Bay of Bengal ..	51		
Wind Power Utilization in India ..	180		
Wood-Boring Pholads (Two), Occurrence at Madras .. ..	59		

# Current Science



Vol. XXV]

JANUARY 1956

[No. 1

	PAGE		PAGE
<i>Mineral Resources and Their Problems</i>	1	<i>The Chemistry of Ferrocene and Related Compounds—S. SWAMINATHAN AND S. RANGANATHAN</i>	6
<i>First Congress on Theoretical and Applied Mechanics</i> .. .. .	3	<i>Indian Science Congress, 1957</i> .. .. .	8
<i>Equilibrium Configurations of Oblate Fluid Spheroids under the Influence of Magnetic Field—S. P. TALWAR</i> ..	4	<i>Letters to the Editor</i> .. .. .	9
<i>Lady Tata Scientific Research Scholarships, 1956-57</i> .. .. .	5	<i>Reviews</i> .. .. .	30
		<i>Use of Radioactive Tracers in the Study of Plant Physiology</i> .. .. .	34
		<i>Science Notes and News</i> .. .. .	35

## MINERAL RESOURCES AND THEIR PROBLEMS\*

FROM the dawn of human civilisation, man had used mineral products, a few at first and more as time went on. The process was slow in the beginning and even at the dawn of the Industrial Revolution, only a few mineral products were used. But during the present century, mankind has used more metals and minerals than during all its long civilised existence. Modern industry is expanding at an ever-increasing pace, and almost every country is now bent upon industrialisation, and the already industrialised countries are steadily expanding their activities. Unlike the products of the animal and vegetable kingdoms, mineral resources are not renewable seasonally or annually, and only under exceptional conditions can supplies be replenished quickly, like sulphur in areas where volcanoes are active. The only way to replace mineral deposits which have been depleted is to find new ones wherever they might occur.

The relative abundance and distribution of the elements in the earth's crust is well known, but it is not their relative abundance that matters so much as the degree of concentration and the quantity in which they are gathered up by natural processes. Such concentrates are our ore and mineral deposits. Most of the ore deposits are usually derived through the agency of magmatic processes, being associated with igneous rocks and emanations. Both the grade of the ore and tonnage have a definite relation to what we consider a workable deposit. What we call a low grade is dependent on economic considerations of winning the useful mineral first by separating it from the unwanted minerals and waste rock, and then processing or smelting it to concentrate the mineral or metal into a usable form. The average content of uranium in rocks of the crust is of the order of two parts in a million. But it will be a very costly proposition to mine half-a-million tons of rock to process it and recover 1 ton of uranium whose market value at present is roughly Rs. 35,000 to Rs. 40,000. Barely a decade ago, a workable uranium ore had to

\* Abstract of the Presidential Address of Dr. M. S. Krishnan, Director, Geological Survey of India, to the 43rd Indian Science Congress, held at Agra, January 1956.

	PAGE		PAGE
Vitamins, Recent Research on (Rev.) ..	205	XANTHOMONAS, Three Undescribed Species of ..	366
Vitexin from <i>Vitex peduncularis</i> Wall ..	328	X-Ray Diffraction in Polycrystalline Materials (Rev.) ..	30
WASTE Heat from Nuclear Reactors, Use of ..	101	YEAST, Relation between the Nucleus and the Vacuole ..	397
Water Requirements of Crops, Apparatus for ..	250	ZONATE Leaf-Spot Disease of Jowar ..	137
— — of Wheat: Variety Kenphad, ..	179	Zoological Society of India ..	208
for Determination of ..	250		
Water-Masses in the Bay of Bengal ..	51		
Wind Power Utilization in India ..	180		
Wood-Boring Pholads (Two), Occurrence at Madras ..	59		

# Current Science

Vol. XXV]

JANUARY 1956

[No. 1

	PAGE		PAGE
<i>Mineral Resources and Their Problems</i>	1	<i>The Chemistry of Ferrocene and Related Compounds</i> S. SWAMINATHAN AND S. RANGANATHAN	6
<i>First Congress on Theoretical and Applied Mechanics</i>	3	<i>Indian Science Congress, 1957</i>	8
<i>Equilibrium Configurations of Oblate Fluid Spheroids under the Influence of Magnetic Field</i> S. P. TALWAR	4	<i>Letters to the Editor</i>	9
<i>Lady Tata Scientific Research Scholarships, 1956-57</i>	5	<i>Reviews</i>	30
		<i>Use of Radioactive Tracers in the Study of Plant Physiology</i>	34
		<i>Science Notes and News</i>	35

## MINERAL RESOURCES AND THEIR PROBLEMS\*


FROM the dawn of human civilisation, man had used mineral products, a few at first and more as time went on. The process was slow in the beginning and even at the dawn of the Industrial Revolution, only a few mineral products were used. But during the present century, mankind has used more metals and minerals than during all its long civilised existence. Modern industry is expanding at an ever-increasing pace, and almost every country is now bent upon industrialisation, and the already industrialised countries are steadily expanding their activities. Unlike the products of the animal and vegetable kingdoms, mineral resources are not renewable seasonally or annually, and only under exceptional conditions can supplies be replenished quickly, like sulphur in areas where volcanoes are active. The only way to replace mineral deposits which have been depleted is to find new ones wherever they might occur.

The relative abundance and distribution of the elements in the earth's crust is well known, but it is not their relative abundance that matters so much as the degree of concentration and the quantity in which they are gathered up by natural processes. Such concentrates are our ore and mineral deposits. Most of the ore deposits are usually derived through the agency of magmatic processes, being associated with igneous rocks and emanations. Both the grade of the ore and tonnage have a definite relation to what we consider a workable deposit. What we call a low grade is dependent on economic considerations of winning the useful mineral first by separating it from the unwanted minerals and waste rock, and then processing or smelting it to concentrate the mineral or metal into a usable form. The average content of uranium in rocks of the crust is of the order of two parts in a million. But it will be a very costly proposition to mine half-a-million tons of rock to process it and recover 1 ton of uranium whose market value at present is roughly Rs. 35,000 to Rs. 40,000. Barely a decade ago, a workable uranium ore had to

\* Abstract of the Presidential Address of Dr. M. S. Krishnan, Director, Geological Survey of India, to the 43rd Indian Science Congress, held at Agra, January 1956.

	PAGE		PAGE
Vitamins, Recent Research on (Rev.) ..	205	XANTHOMONAS, Three Undescribed Species of ..	366
Vitexin frm <i>Vitex peduncularis</i> Wall ..	328	X-Ray Diffraction in Polycrystalline Materials (Rev.) ..	30
WASTE Heat from Nuclear Reactors, Use of .. ..	101	YEAST, Relation between the Nucleus and the Vacuole .. ..	397
Water Requirements of Crops, Apparatus for ..	250	ZONATE Leaf-Spot Disease of Jowar ..	137
— — of Wheat: Variety Kenphad, ..	179	Zoological Society of India ..	208
for Determination of .. ..	250		
Water-Masses in the Bay of Bengal ..	51		
Wind Power Utilization in India ..	180		
Wood-Boring Pholads (Two), Occurrence at Madras .. ..	59		

# Current Science



XXV]

JANUARY 1956

[No. 1

	PAGE		PAGE
<i>Mineral Resources and Their Problems</i>	1	<i>The Chemistry of Ferrocene and Related Compounds—S. SWAMINATHAN AND S. RANGANATHAN</i>	6
<i>Congress on Theoretical and Applied Mechanics</i>	3	<i>Indian Science Congress, 1957</i>	8
<i>Equilibrium Configurations of Oblate and Spheroids under the Influence of Magnetic Field—S. P. TALWAR</i>	4	<i>Letters to the Editor</i>	9
<i>Tata Scientific Research Scholarships, 1956-57</i>	5	<i>Reviews</i>	30
		<i>Use of Radioactive Tracers in the Study of Plant Physiology</i>	34
		<i>Science Notes and News</i>	35

## MINERAL RESOURCES AND THEIR PROBLEMS\*

FROM the dawn of human civilisation, man had used mineral products, a few at first more as time went on. The process was in the beginning and even at the dawn of the Industrial Revolution, only a few mineral products were used. But during the present century, mankind has used more metals and minerals than during all its long civilised history. Modern industry is expanding at an increasing pace, and almost every country is now bent upon industrialisation, and the highly industrialised countries are steadily increasing their activities. Unlike the products of animal and vegetable kingdoms, mineral resources are not renewable seasonally or locally, and only under exceptional conditions can supplies be replenished quickly, like fur in areas where volcanoes are active. The only way to replace mineral deposits which have been depleted is to find new ones wherever they might occur.

The relative abundance and distribution of the elements in the earth's crust is well known, but it is not their relative abundance that matters so much as the degree of concentration and the quantity in which they are gathered up by natural processes. Such concentrates are our ore and mineral deposits. Most of the ore deposits are usually derived through the agency of magmatic processes, being associated with igneous rocks and emanations. Both the grade of the ore and tonnage have a definite relation to what we consider a workable deposit. What we call a low grade is dependent on economic considerations of winning the useful mineral first by separating it from the unwanted minerals and waste rock, and then processing or smelting it to concentrate the mineral or metal into a usable form. The average content of uranium in rocks of the crust is of the order of two parts in a million. But it will be a very costly proposition to mine half-a-million tons of rock to process it and recover 1 ton of uranium whose market value at present is roughly Rs. 35,000 to Rs. 40,000. Barely a decade ago, a workable uranium ore had to

\*Abstract of the Presidential Address of Dr. M. S. Mani, Director, Geological Survey of India, to the Indian Science Congress, held at Agra, January 1956.



contain not less than 2% of that element. But the demand that has been created after the discovery of atomic energy makes it now worthwhile to mine and process an ore containing only 0.1% uranium.

As is well known, only a few limited areas in the world have been searched intensively for minerals. Such areas are to be found around the North Atlantic, *viz.*, in Western Europe and North America. In other parts of the world, only a few small areas have been examined in detail. The greater part of South America, Africa and Asia remain to be explored with care. In Asia and Africa there are regions which have not yet been mapped geologically. Under the circumstances, it is reasonable to expect that intensive exploration and prospecting would lead to the discovery of a number of mineral deposits of which some at least would be of importance.

In all countries, early in the process of industrialisation only the richest deposits exposed at the surface were worked and utilised locally or exported. Much wastage occurred at this stage. This was soon followed by industrial development marked by the setting up of metallurgical, chemical and engineering works. The national wealth and prosperity of a country increased during this stage. The third stage is a period of depletion of cheap domestic mineral resources and import of raw materials from outside for feeding local industries. Thereafter comes the stage of having to depend on foreign ore and other raw materials, leading gradually to the loss of competitive power in foreign markets, due to the necessity for purchase of much of the raw material requirements from outside.

India is just passing through the first stage and entering the second. The further stages could be strengthened by careful husbanding of the resources by the adoption of conservation measures. An outstanding example in India, requiring the enforcement of conservation, to which repeated attention has been called, is the misuse of good coking coal for burning in boilers and locomotives for steam raising, for which non-coking coal of a similar grade would do quite well. It is only during the last four or five years that serious steps have been taken to prevent the objectionable use of coking coal.

Conservation has to be effected at all stages of the development of the mineral deposits, in mining, milling and ultimate utilisation. All technological advances in any of these stages automatically bring in improvements which are conducive to conservation. Conservation

is also achieved by substituting a more easily available and cheaper material for one which is costly or difficult to get. Substitution is often dictated by necessity, and will be acceptable so long as the easily available substitute is good enough for the purpose for which it is intended. Thus, though it may be worth while using a good grade of mica for all types of electrical insulation, a poorer insulator would serve for some purposes. Mica substitutes are, therefore, coming into use in the countries which have to import this mineral in large quantities.

It is an interesting fact that no mineral has become entirely obsolete and unusable. The pattern of use may change occasionally, but so long as a mineral finds some use, it continues to be employed until it is replaced by something more suitable or is used for some other special purpose. A good example is afforded by monazite for which the black sands of the Travancore coast were originally worked. It was then employed for the requirements of the gas mantle industry. But, after the First World War, the demand for the mineral fell and practically stopped, as gas had largely been replaced by electricity for lighting in Europe. In the meanwhile, ilmenite which is associated with the monazite, found use in the manufacture of a paint pigment—titanium white. This mineral rapidly assumed importance and monazite was nearly forgotten for a while. But during and after the Second World War, monazite has again attained prominence as a possible source of atomic energy because of its content of appreciable amounts of thorium and a little uranium. Ilmenite also continues to be utilised, so that at present there is a good demand for both these minerals.

The latest prophecy seems to be that atomic energy is going to make coal an unwanted material and that coal mining will be a thing of the past within a decade. But we may well ask whether all the uranium needed for bringing about such a complete revolution in the industrial set-up and power production will be available (as also other materials needed for regulation and control of the nuclear reactions) at a price which will compete seriously with coal. Similar prophecies were made about coal when large developments in the production of petroleum as well as of hydro-electricity took place three or four decades ago. There are as yet no signs of coal becoming unnecessary to mine.

Our present knowledge goes to show that we have only a few surpluses and quite considerable deficiencies in the list of useful mine-

erals needed for industry. There is a sufficiency of surplus in coal, ores of iron, manganese, aluminium, titanium, chromium, magnesium; mica, barytes, kyanite, sillimanite and various types of clays. The chief deficiencies are in copper, lead, zinc, silver, nickel, cobalt, molybdenum, tungsten, tin, antimony and mercury amongst the metals; and sulphur, phosphates, fluorspar, petroleum, potash, graphite, asbestos, amongst the non-metallic minerals. In almost every case our knowledge is confined to surface observations. We do not know enough about what lies below the surface even at shallow depths. There is, consequently, a chance of making good some of the deficiencies by extensive and intensive search in suitable areas.

Only during the last few years has the Geo-

logical Survey been strengthened suitably in personnel and equipment to face this task adequately. A Bureau of Mines has been established to look after the work of improving the techniques and standard of mining and enforcing mineral conservation measures. An Oil and Natural Gas Division is being set up to undertake systematic and intensive exploration for petroleum. Within the Geological Survey itself there are specialist wings to study Mineral Deposits, Groundwater and Engineering Geology and to conduct Geophysical Exploration. The co-ordinated efforts of all these will be directed towards the study of all the phases of exploration and development of our resources in minerals, and will contribute steadily to the building up of a strong and prosperous nation.

#### FIRST CONGRESS ON THEORETICAL AND APPLIED MECHANICS

**T**HE First Congress on Theoretical and Applied Mechanics was held on the 1st and 2nd November 1955, at the Indian Institute of Technology, Kharagpur, under the Presidentship of Dr. K. S. Krishnan, Director, National Physical Laboratory, New Delhi. Of the 147 delegates who registered themselves as members, 101 participated in the deliberations of the Congress. Fifty-two papers were read and were followed by lively discussion. Messages of goodwill were received from a number of distinguished workers all over the world.

Dr. S. R. Sen Gupta, Chairman of the Organizing Committee, stressed the need for both theoretical and experimental approaches to any problem of mechanics and advocated a harmonious blending of the two. This was followed by the Presidential Address on 'The Physics of Heated Filaments in Vacuum'. The theory developed by Dr. Krishnan knits into a single whole the uncorrelated empirical results obtained by various experimenters.

There was a half-hour address by Prof. N. Wiener on 'Some Formulæ in Meteorological Prediction'. He showed how with the help of a lemma formulated by him and Kolmogoroff, formulæ for multiple prediction may be developed making use of phase averages or time averages. Other addresses were by L. E. Payne 'On a Class of Problems in Plane Elasticity' and by V. M. Ghatage on 'Ring Aerofoils and Their Possible Use'. Dr. Payne showed how in the problem of semi-infinite elastic medium or of an infinite strip the use of dual integral equations may be avoided by a suitable decomposition of Airy's stress function. Dr. Gha-

tage indicated an interesting arrangement of a ring aerofoil and a source which could climb in the vertical direction without any horizontal race on the ground, and could also move backward or forward. Though a practical design of this type had not been worked out, it was quite feasible and deserved thought and consideration. A majority of the papers presented at the Congress dealt with problems on elasticity and plasticity. Among the other topics discussed were fluid mechanics, callistics, vibrations, thermodynamics, statistics and mathematical physics.

An *ad hoc* meeting was held for the formation of the Indian Society of Theoretical and Applied Mechanics. The following office-bearers were elected: Dr. K. S. Krishnan (President), Dr. V. M. Ghatage and Prof. N. R. Sen (Vice-Presidents), Prof. B. R. Seth (Secretary-Treasurer).

The First Congress on Theoretical and Applied Mechanics has served a useful purpose in bringing together workers in engineering science from all parts of India, and emphasising the need for producing engineer-scientists along with the establishment of colleges for producing working engineers. It may be essential for this purpose to enrol brilliant graduates from Indian Universities with high academic distinctions in basic sciences like applied mathematics, physics, chemistry, geology, geophysics and statistics, and engage them in research work in theoretical and applied mechanics and other basic subjects on which the science of engineering is built up.